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Draining Downspouts into Filters

A FILTRATION engineer has sent the Engineering Record a protest against the practice of turning down-spouts onto filter surfaces. The amount of water obtained in this way is small in comparison with the output of the plant, but the accumulations of soot, bird droppings and other objectionable matter washed in from the roof of the filters may be considerable. The effect of this practice is so marked at a small plant in Michigan that large pieces of soot are noticeable on the surface, which is much darker than is the sand at a shallow depth. "Important or not from a sanitary standpoint," says the engineer, "this practice is not desirable from an aesthetic standpoint, and if it has paid the city of Cleveland to cover its coagulating basins for the purpose of eliminating soot, I believe that it would be a step in the right direction for designers of filter plants to cease making the provision for carrying the soot from roofs into the filters." The matter is worthy of consideration, for it is not uncommon to see water dripping from these drains onto the sand when the filter is out of service. Small holes are thus bored into the bed, into which are carried the accumulated impurities previously removed from the water. It is not inconceivable that pollution may reach the underdrains through this shortened route and thus for a short time contaminate the supply.

Misleading Railroad Statistics

NOT a passenger was killed during 1914 in a train accident on the entire Pennsylvania system of 26,198 mi. of track. Nevertheless the accident reports of the Interstate Commerce Commission make it appear that there were nineteen such fatalities. As a matter of fact every one of these accidents, according to a statement issued by the company, was due to carelessness on the part of the victims or to some other cause of which the railroad had no control. The practices of getting on and off moving trains, standing too close to the tracks and crossing in front of trains all claimed their quota of lives. One of the nineteen jumped off a ferry boat. Another jumped between moving cars. Still a third was attacked by another passenger and thrown from the train. In addition to these passenger accidents which are laid to the railroad company 301 deaths to trespassers are charged to so-called "railroad accidents," in spite of the vigorous campaign being conducted by the company against trespassing and stealing of rides—a campaign in which the railroad gets all too little support from local officers charged with the enforcement of the law. It is regrettable that the Government still sees fit to give out these misleading statistics, which are seized by certain irresponsible newspapers and made the basis of further tirades against the railroads.

Trade Wastes in City Sewers

PEOPLE have been in the habit of thinking that municipal sewers should be used for wastes of every sort. Years ago, when the need for the treatment of sewage before its admission to a water-course was not felt, this belief did no serious damage. To-day, however, the problem is more complicated. Sewage treatment works are increasing in number and their successful operation depends upon the character of the sewage they are called upon to handle. Certain wastes from manufacturing processes are not amenable to purification at the ordinary municipal plant, and, in fact, if allowed in considerable quantities will decrease the efficiency of the works, increase the cost of maintenance, and interfere with the successful operation of the plant. The question then arises, "To what extent should manufacturers be compelled to treat their sewage before discharging it into the municipal system?" The subject is discussed in detail in an article on page 256 by W. L. Stevenson, assistant engineer of the Bureau of Surveys, Philadelphia. Before this city adopts its comprehensive plan of sewage treatment, as required by law, it is reasonable to infer that some restrictions will be placed on the character of the wastes which may enter the city's sewers. Engineers in many other large cities will have to face this problem before long, if it has not already presented itself. Mr. Stevenson has gone to considerable pains to collect data bearing upon practice both in this country and abroad. His article is a valuable contribution on a subject of ever-increasing importance.

Reunions of the School of Experience

THE gratification which attends the completion of a large engineering work is always tempered by the sadness incident to the disruption of friendly ties when the final estimate is made. The same feelings attend every college commencement, but by the annual class reunions the colleges offer opportunities for renewing old friendships. Of late there has been a tendency to introduce the reunion idea in connection with large engineering works. The men who were engaged on the Pennsylvania tunnels in New York, for example, have held several reunions since the construction was finished. The latest effort along this line is that of the engineers who served on the Wallkill and Esopus divisions of the Catskill Aqueduct. It is proposed to form an association of the former members of these two divisions and to strengthen the old bonds of comradeship by holding annual reunions. The plan is to be commended. The very nature of an engineer's work makes him more or less of a wanderer, and the friendships he forms on one job are generally broken when he moves to the next. Annual reunions of the "alumni" of an engineering organization will do much toward preserving the old ties. The plan appeals to the best in every man, and even though no return can be figured in dollars and cents, the idea should spread. It is but another way of fostering the human side of the engineer—a side too often neglected.

Working with the Chamber of Commerce

CHAMBERS of commerce, merchants' associations and municipal leagues have been performing valuable work in American cities in encouraging that civic introspection which precedes protest against abuses and appreciation of public needs. Necessarily their activities have dealt largely with engineering affairs. The recent annual report of the Chicago Association of Commerce, however, indicates, even to the initiated, a surprising variety of activities in technical matters. Committees have reported on or are studying fire prevention; good roads, in the county and the State; rapid-transit subways; sewage disposal; railway terminals, both freight and passenger; industrial education in the public schools; paving; smoke abatement and railway terminal electrification; harbors; inland waterways, and subsurface utility structures. It is manifest that the work of the association calls for much assistance from engineers. Their counsel is essential if these activities are to be properly directed. It may be objected that participation in such committee work would be giving free advice. To a limited extent this may be true, but the surest way of securing proper appreciation of the need for engineering services and of insuring the employment of engineers when that need is developed is to have engineers on the committees. The engagement of Dean W. F. M. Goss on the smoke and electrification committee, and of John W. Alvord on the subsurface investigations committee is proof sufficient that the Chicago association, at least, is ready to employ competent engineers when the matters in hand go beyond the point where the casual advice of engineer-members of committees is sufficient. There is here an excellent channel through which an engineer can discharge his civic duty, and an opportunity for local societies to co-operate with the merchants' association. The latter would, without doubt, welcome the proffer of assistance.

Effective Health Messages

IN issuing its monthly bulletin for January in the form of an almanac the New York State Department of Health has endeavored to secure for its propaganda a wider publicity than is possible with a bulletin of the ordinary sort. The almanac feature of the booklet occupies the right-hand pages, while on the facing pages are little sermons on such subjects as typhoid prevention and protection of public water supplies, with some medical topics not within the sphere of engineering. Many of these bulletin-almanacs will go to dwellers in rural communities, and it is apparent that the Department of Health has been studying its audience and is trying to carry its message to these people in the most effective way—by producing a booklet which will be interesting enough to hold their attention. There is a lesson in this for the engineer. When he is endeavoring, for example, to secure an appropriation for some municipal engineering work he, too, should study his audience, and as a result issue a report which is understandable by the layman. The public's indifference to the engineer's work is largely attributable to its ignorance of what he is doing. For this attitude the engineer is, in some measure, to blame.

How Can Annual Reports Be Improved?

AT this time of the year the annual reports of city engineering departments for 1914 are being sent out. A great many have already been received by the Engineering Record and an examination of them suggests the need for discussing again the ways of making such reports of greatest value to those for whom they are written.

At the outset it is pertinent to inquire, "What is the object of an annual report?" It would seem, primarily, that an annual report should tell the taxpayers what has been done with their money during the year. A secondary object is to place on record data of engineering value so that by exchanging reports with officials of other cities the experiences of one locality may be made available for the solution of similar problems elsewhere. If this be correct, it is necessary to consider how this information can best be conveyed to those for whom it is intended.

Engineers have apparently proceeded on the assumption that their task is done when they present the results of the year's work in the form of a colorless statement of feet of water main laid, and square yards of pavement resurfaced, accompanied by page after page of tabular matter, showing the minutest details. The reason for this conception of the form of a report is not difficult to find. The engineer does not set before himself clearly its purpose, he does not form a concept of the character of his audience, or if he does he lacks the skill necessary to present his facts in a convincing manner. But, fortunately, ideas are changing. Any one who has followed the trend of thought as expressed at meetings of engineering societies recently must realize that the demand for proper recognition of the engineer's work is growing more insistent, and that the help to be secured from properly prepared reports is being appreciated.

Every report should begin with a summary, in non-technical language, giving the achievements of the year. In this summary, intended primarily for the taxpayer, only the larger phases of the work should be dealt with. It is a mistake to dilate upon details or routine matters. The outstanding events of the year should have first attention and then the broad questions of policy which have influenced the department. The purpose of the engineering structures being built and their effect on the physical development of the city must be brought out clearly. The public will be interested in these things, if told in simple, non-technical language.

Often the opening sentences of a report commend or condemn it. One report, recently received, opens with the sentence, "The city of ——— lies in latitude—— and longitude ———." This report then goes on to list the names of the railroads entering the city. There is no surer way of killing the reader's interest. If the city is spending thousands of dollars on a new sewerage system and treatment works, as this one is, why not start with a description of this all important work? Who cares for a reiteration of a city's latitude and longitude when there are matters of more immediate interest at hand? By the inclusion of such superfluous material important achievements are obscured, and yet engineers wonder why their efforts are not appreciated.

Then again consider the question of tabulated data. This journal can see no reason for filling dozens of pages with tables showing the number, size and location of valves. This information is valuable. Its place, however, is in the office files and not in a report sent out broadcast. The same observations apply to statistical matter on hydrants, pipe, meters and street paving. A summary is desirable, but detailed tables are a waste of space. Worse still, they make a report forbidding and insure its neglect by those who should read it.

When certain bureaus—such as a sewage-testing station, or a street-cleaning division—have accumulated especially valuable or interesting material, the data are best put in an appendix, and only a summary of results in the general report.

Finally, copies of the introduction, by itself, should be sent simultaneously to all the local newspapers, at the same time offering to give them detailed information on any subject referred to in the report. Some engineers are adverse to such procedure, but since the object of their report is to place the operations of their department before the public, they should accept the most satisfactory medium—the daily press—for securing the desired publicity. In some cities—Philadelphia, notably—this idea has been grasped, much to the benefit of the public and the department in question.

Inefficient Preliminary Education

IN his recent report to the Board of Overseers, President Lowell of Harvard brings to the front some rather grim details as to the present condition of higher education. He calls attention to the fact that the entering class averages eighteen years and six months at admission, and very pointedly remarks that "boys of ordinary capacity could by beginning young enough be ready to enter college a year earlier than most of them do now, and they would be perfectly competent to pursue the courses of even the best colleges."

Considering the amount of special training required to enter into any professional or technical career, to start in serious study at eighteen and a half is certainly a handicap. A young man who enters at that age will be twenty-five or six before he gets out of the law school, medical school or special engineering schools and after that he has several years of gruelling hard work ahead of him before he fairly gets settled into the bearings of his professional life. It is bad not only for the individual, but for the community to have its best-educated classes well on toward thirty before they become efficiently self-supporting. The increasing requirements in every sort of professional work are a serious enough obstacle without the additional one of a late start, and President Lowell is perfectly right in saying that this late start is unnecessary and deleterious. If one will pick up the curriculum of any first-class institution and look over the studies required or available during the freshman year, he will at once realize that any boy of seventeen who is clever enough to justify him in undertaking professional pursuits is quite able to pursue the studies at his disposal the first year in college.

The vital question is why the average boy is a year or a year and a half behind at that age. The answer is that a very large amount of time has been wasted in pursuing non-essentials and in studying essentials inefficiently during the previous year of school life. The high schools and similar institutions are partly at fault, in that they cannot or will not enforce habits of application while the student is in their hands. It is the almost universal experience of intelligent young men to discover during freshman year that they have not yet learned how to study to good advantage, by reason of a certain shiftlessness in the preparatory school.

Pushing the matter back even a little further it will be found that the boy in high school is as a rule handicapped by lack of thoroughness in the rudimentary and fundamental things which he should have mastered in the previous four or five years. Perhaps the most serious difficulty in these beginnings is that the ordinary school is run without due regard to the needs of the more intelligent class of pupils, and the whole course of affairs drags along by methods which may be very well adapted to the stupid and shiftless but which seriously handicap those who are able and reasonably willing to learn. The lower schools are operated on the lock-step principle, at a pace adapted to dragging the unwilling. The result is that the intelligent boy reaches high school without any intellectual stimulus and equipped only with a medley of things half learned which he has picked up on the way. He naturally finds it difficult to apply himself, it having heretofore been unnecessary, and slips into college without that mental discipline which at that particular period of his evolution he most acutely needs. Consequently it frequently takes him a couple of years to get into his mental stride. One cannot help feeling a great deal of sympathy with President Lowell's point of view in this matter, although the remedy for the present state of things is not easy to apply.

State Technical Bureaus and the Consulting Engineer

ACTIVITIES of university extension departments in Iowa and Minnesota aroused adverse criticism last week at the meetings of the engineering societies of those States. Tendencies toward paternalism in engineering work, seemed, to many Iowans, to be wresting from them the cream of the consulting engineer's business, that of giving broad general advice. Such work, instead, would be given to the State-paid engineers of the Iowa Technical Service Bureau, a recent development of the extension division of the Iowa State College. Dean Anson Marston explained that the work of the bureau was to be confined exclusively to research and to the education of public officials to a better realization of the necessity of obtaining competent engineering advice. Since the service is free every municipality wants to get as much of it as it can. There have been many rumors and some newspaper accounts exaggerating the amount of help that the bureau proposes to give.

In Minnesota the work is somewhat further advanced and is complicated by the activities of the League of Minnesota Municipalities. A few months ago the league appointed an engineer to whom the secretary was to turn over inquiries of an engineering nature. He cares for them directly or designates some other engineer as being available. In Iowa, when such a request comes to the service bureau, no specific recommendation is made, but a list of all reputable Iowa engineers is furnished. In both States the men making preliminary investigations claim that they are increasing the total amount of work for consulting engineers, but, as Dean Marston admitted, the situation is a delicate one, and can only be handled satisfactorily by the engineers and the bureau working in harmony and with the utmost frankness.

There is a feeling in Iowa that this is simply an entering wedge which will ultimately drive out of the State practically all of the engineers who serve as consultants to the smaller cities. In Minnesota the League of Municipalities has discussed the desirability of maintaining a technical staff with district engineers to whom the problems of small towns would be referred. This service would be paid for at regular fees.

It cannot be denied that there is a field for the State's service—that there are communities which of themselves would not rise to the necessity for engineering work. They need some one to stimulate their interest, to point the need; and a disinterested party is more likely to be successful than one who can directly profit by the work. These bureaus, moreover, should be able to give communities some notions as to proper procedure in employing engineers, and thus aid in putting a stop to the disgraceful scramble common in the engagement of engineers in smaller communities. The present system is to ask in all the engineers within a radius of 250 miles, to get as much general information as possible, and then beat down the engineers to the lowest possible figure. Bids for services are sometimes taken and in one instance in Iowa these bids, by the score or more of engineers who probably spent at least $25 apiece in traveling expenses and as much more in time, ranged from $300 to $7500 for the plans and supervision of a proposed sewerage system. Some one, and eventually the people, must pay for these losses, and while the co-operative plan of the Minnesota cities may not be the best, co-operation of some kind seems necessary. The small towns need assistance, and their banding together in the league indicates that they propose to get it. If the engineer does not like their methods, he must meet them half way with some better plan. So far as the representative of this journal could ascertain the engineers were being importuned to assist in formulating a plan that would attain the ends sought and still be satisfactory to them. In one direction it is certain that their influence should be made felt—to have the league, if it continue to assist its members in securing engineers, insist upon the full fees being paid. If that be done the biggest point will be gained, for the danger inherent in both the State's work and that of the league is the cheapening of engineering services.

The Plain Truth

AT last a distinguished member of the profession has had the courage to tell the truth—to tell engineers that they have not deserved the recognition that they have craved in public affairs, that the fault is their own if lawyers and business men enjoy a higher place in public esteem.

It is the fashion in the profession to storm against the failure of the people at large, of politicians, and even of men of affairs, to appreciate the ability of engineers. The wrath has been based on the assumption that the public, not the engineers, is at fault. Not so, says Professor Swain, the fault is in ourselves, not in the public.

The analysis he made at the meeting of the American Institute of Electrical Engineers last week is a careful examination of the qualities which make for leadership and a heartless but fair comparison, on the basis of these qualities, of the engineer with the lawyer and the business man. In all candor he is forced to admit that in breadth of vision, the engineer, speaking generally, must take second place to the lawyer, and the business man; and that in clarity of thinking the lawyer is the engineer's superior. Moreover, the qualities, largely inherent, of character, presence, tact and ability to handle men, are not, in general, possessed in greater measure by engineers than by lawyers and business men. With, therefore, equal ability as far as the inherent qualities go, and greater ability, so far as the characteristics dependent largely on training—directness in thinking and breadth of vision—are concerned, the lawyer and the business men are entitled to the leadership accorded them.

This truth, unquestionably, has impressed itself on many eminent engineers and teachers, but no one has had the courage to enunciate it. Even the engineers, distinguished and surely unafraid, who spoke from the same platform with Professor Swain last week, contented themselves with protest against the ignoring of the engineer, or with reiteration of the fact, well known, that some engineers do ascend to top rank. It remained for Professor Swain to seek out the causes for the failure to recognize the profession as a whole and then to bring the indictment. His address, printed on page 261, should excite much comment and encourage introspection.

If Professor Swain was in the right—and who that has had the hiring of men can deny it—engineers generally should address themselves to the solution. Simple of statement it is, but difficult of achievement. We must, in a word, develop engineers fitted for leadership. "The engineer, if he have the personality, can lead and hire the legal and the business brains and knowledge," says Professor Swain. The fundamental material then must be of a higher order, so that the inherent qualities may be present; the training must be severe, the fundamentals insisted upon; and finally there must come the broadening influence of literature, history, psychology. Who will doubt that we should not need to worry about recognition from the public, if we had the men to command it. Eminent practitioners in every branch of engineering give proof that the places are there for those with the ability to take them. In almost every city and section engineers are high in the intellectual, commercial and social life of the community. The basis for the complaint is that there are not enough engineers in eminent position, and that the highest places do not go to them.

The conclusions to be drawn from Professor Swain's address—the conclusions he himself has drawn—are applicable to the individual, as well as to the molding of the engineers of the future. This journal believes that the elevation of the profession will come more rapidly from such individual application of the conclusions—from honest endeavor to remedy personal deficiencies in training—than from years of protest against the present order. "We may rest assured" Professor Swain concludes, "that if the engineer be possessed of these qualities for leadership, leadership will come to him."

Maintenance of Sewers and Disposal Works Demands Treatment of Injurious Trade Wastes

Damages to System Justify Exclusion of Harmful Liquids Produced by Industrial Plants—Digest of American and European Regulations

By W. L. STEVENSON
Assistant Engineer, Bureau of Surveys, Philadelphia

THIS paper deals with the admission of trade wastes to the sewerage system. It shows abstractly and by concrete example the harmful effect of certain trade wastes upon the sewers, sewage treatment works and the receiving body of water. This subject has been given much study in England and therefore the national and some local regulations of that country are given, in order that the regulations in American cities may be better understood and probably improved.

CLASSIFICATION OF TRADE WASTES

Trade wastes may be divided into three classes as regards the results of their admission to the sewerage system:

1.—Those trade wastes whose effects upon the sewerage system are not different from ordinary domestic sewage. This class does not enter the discussion.

2.—Those trade wastes which have no injurious effects upon the sewers or the receiving body of water, but whose characteristics are sufficiently different from domestic sewage to require specially designed treatment works when the wastes are added in sufficient quantity to the town's sewage.

3.—Those trade wastes whose physical condition or chemical composition is such that they should not be admitted to the sewers except after sufficient treatment to remove the characteristics injurious either to the sewers, sewage treatment works or the receiving body of water.

Examples of the conditions described under class 2 exist in Bradford and Burton-on-Trent, England. In the former city about one-half of the sewage treated consists of trade wastes containing an abnormally large amount of fats, and the sewage treatment works are especially designed for grease recovery. The sewage treatment works of the latter city has special features in order to handle sewage containing wastes from brewing, which is the principal industry of Burton.

In regard to the methods used for the partial or complete treatment of trade wastes by the producer, there is considerable literature available and this phase of the problem will not be discussed.

EFFECTS UPON SEWERS

Sewers and sewage treatment works are usually designed either for strictly domestic sewage or for sewage containing but a small proportion of trade wastes. These originate in so many different industries that there is wide divergence in their composition and many are materially different in condition and composition from domestic sewage. The relative volume of the trade wastes to the domestic sewage is of great importance. For instance, a large manufacturing plant connected to the sewer system of a small town may so predominate that the sewers will really be carrying trade waste diluted by sewage. On the other hand, the wastes from the same plant, if discharged into the main sewer of a large city, might lose their identity in the large volume of domestic sewage. In the following discussion the reader should bear this idea in mind.

CARRYING CAPACITY OF SEWER REDUCED

Decreased Cross-Section.—The cross-section of a sewer may be decreased by the formation of deposits of substances in trade wastes not maintained in suspension by velocities of flow sufficient to keep clean sewers carrying domestic sewage. These deposits, by forming a dam, also decrease the velocity in back of the obstruction whereby deposits of sewage matters are formed, which by subsequent decomposition and putrefaction foul the otherwise fresh sewage flowing over them. Among trade wastes liable to form such deposits are washings from marble yards and wastes from skin-dressing establishments where lime is used to remove hair from the hides. A hard mortar-like deposit has been found in sewers opposite lateral connections from such factories. The cross-section may also be decreased by the adherence to the sides of the sewer of substances of a gummy or gelatinous nature such as are discharged from glue factories.

Roughened Interior Surfaces.—Both of the above mentioned conditions further reduce the carrying capacity of the sewer by raising the coefficient of roughness of the wetted perimeter. Gagings have been made in sewers which indicate a coefficient of roughness of 0.017 or 0.019, whereas the original materials of construction in a normal condition would have had a coefficient of 0.015.

INJURY TO FABRIC OF SEWER

Corrosion and Softening of Joints.—The admission to sewers of certain trade wastes may injure the fabric of the mortar joints in brickwork, by the corrosion of concrete, or by the softening and ultimate destruction of bituminous joints of vitrified clay pipe sewers. In addition to shortening the life of the sewer, these conditions all tend to increase the amount of ground water which leaks in and becomes an important matter when the sewage has to be either pumped or treated. Trade wastes containing an amount of free acid sufficient to more than neutralize the natural alkalinity of domestic sewage may produce these corrosive actions and the discharge of steam or hot liquids into sewers may soften the bituminous joints.

Inflammable Gases.—Within the past few years widespread interest has developed in the many cases of explosions in sewers. While some of these have been attributed to illuminating gas, many have been due to the discharge into the sewers of inflammable substances such as waste gasoline from garages or benzine from cleaning establishments. Many of these explosions have been fatal to workmen engaged in cleaning or repairing the sewers. Examinations of sewers in the vicinity of works using large amounts of oil or having the exhausts of gas or oil engines directly connected to the sewer have shown the presence of inflammable gases.

EFFECTS UPON SEWAGE TREATMENT WORKS

The English Royal Commission on Sewage Disposal, after 10 years investigation, states in the fifth report its conclusion on the effect of trade wastes upon sewage treatment:

> All the trade effluents of which we have had experience interfere with or retard processes of purification to some extent, but we are not aware of any case where the admixture of trade refuse makes it impractical to purify the sewage either upon land or by means of artificial processes, although in certain extreme cases special processes of preliminary treatment may be necessary.

The deleterious effects of certain trade wastes may consist in decreasing the efficiency, increasing the cost of operation, or even seriously interfering with the successful operation of sewage treatment works.

The sudden discharge into the sewers of large volumes of trade wastes high in suspended matter may increase the velocity of flow and decrease the retention period in sedimentation tanks at the time when the sewage is carrying an unusually large amount of suspended matter and thereby produce temporarily an inferior quality of tank effluent.

Decreased efficiency in oxidizing processes may be caused by the discharge of sufficient quantities of trade wastes having germicidal properties, such as refuse from tanneries working hides preserved in arsenic, whereby the biological forces are interfered with.

The discharge into the sewers of trade wastes of very putrefactive composition, such as from skin-scraping and bone-boiling establishments, may hasten decomposition in the sewage to such an extent that the sewage may be so foul when it reaches the treatment works that it becomes practically impossible to prevent bad odors during treatment. Whereas in properly designed and maintained sewers and treatment works it is possible by cleanliness to almost insure the inoffensive treatment of the sewage.

INCREASED COST OF OPERATION

Ordinary domestic sewage in America contains from 200 to 400 parts per million suspended solids. Such trade wastes as are obtained in wool washing and blanket scouring have been found to contain from 16,000 to 11,000 parts per million suspended matter. When it is considered that the sludge collected in the sedimentation tank is composed of the suspended matter in the sewage and that the sludge is one of the difficult and expensive parts of operation, the effects of the discharge of such trade wastes as shown above upon cost of operation becomes very apparent.

In many English works where chemical precipitation is used it has been found that the presence in the sewage of certain trade wastes requires the use of very much larger quantities of the chemicals to produce a proper tank effluent.

Sewage treatment works in successful operation may be so seriously affected by the admission of sufficient quantities of certain trade wastes that it will be unable to accomplish the results for which they were constructed. This occurred during the winter of 1908-09 at the sewage treatment works of Hudson. The intermittent sand filters successfully treated the town's sewage until a connection was made discharging wool washing waste into the sewer. This waste contained large amounts of fats, which so completely clogged the sand beds that the sewage stood to a depth of several feet upon them. It became necessary later to make additions to the works. Subsequently the manufacturer installed a grease recovery plant and the trouble was ended.

Another case of serious interference due to trade wastes occurred at Shelby, Ohio, where acid pickling waters ruined the sewage treatment works. Later the manufacturer installed an iron sulphate recovery plant, the effluent of which produced no injurious effects.

EFFECTS UPON RECEIVING BODY OF WATER

When sewage is discharged into water-courses having a sufficient volume and velocity to dispose of it inoffensively by dilution, the natural biological forces ultimately convert the organic sewage matters into stable mineral substances, gases or the living tissue of plants or animals. But the presence in the sewage of certain trade wastes may cause serious injury to a receiving body of water due to their composition.

Many varieties of fish are not only able to live in water containing some pollution but actually obtain their food supply from the plant and animal life plentiful in such water. But certain trade wastes contain substances which clog the gills of the fish and cause their destruction.

Wastes from tanneries may contain the dreaded germ of anthrax, which is so fatal among cattle, and the discharge of such wastes without treatment into water-courses become a menace to cattle using the stream.

TASTES AND ODORS

Wastes containing creosote and refuse from gas manufacture have imparted objectionable tastes and odors to river water which even efficiently designed water filters are unable to remove. This has occurred in the water supply of Philadelphia taken from the Schuylkill River. Freshets in the river have stirred up deposits upon the bed and liberated these substances to such an extent that the preliminary and slow sand filters were unable to remove the offensive tarry taste and odor.

RÉSUMÉ

It has been shown above that certain crude trade wastes when discharged into the sewerage system cause a reduction of carrying capacity, injury to the fabric of the sewer or danger to workmen engaged therein, serious interference with the operation of sewage treatment works, or objectionable pollution in the receiving body of water. Abstractly, these wastes should not be admitted to the sewer system unless treated at least to a degree to remove the menace. The admission to the sewers of those trade wastes which may decrease the efficiency or increase the cost of operation of sewage treatment is largely a matter of policy and cities have very divergent regulations regarding such wastes.

A subject hardly within the scope of this paper and therefore only mentioned is the possibility of recovery of by-products from trade wastes. In some cases this not only removes objectionable characteristics but actually yields an income to the manufacturer and in other cases at least pays the expense of operation of the process.

INVESTIGATIONS BY BUREAU OF SURVEYS

A comprehensive plan for the collection, treatment and disposal of the sewage of the city of Philadelphia has been prepared by the Bureau of Surveys, under the direction of George S. Webster, chief engineer, and George E. Datesman, principal assistant engineer. In order to learn the regulations regarding the admission of trade wastes to the sewers of other cities the writer made a search of all available literature on the subject and corresponded with city engineers, works managers and other officials in America and England. It is a pleasure to record the cordial responses received and again to express appreciation of the courtesies shown by these gentlemen. The following information regarding legislation is published with the permission of George S. Webster, chief engineer.

LEGISLATION IN ENGLAND

The dense population, intense industrial development and comparative small size of the rivers in England have forced those in authority to give much consideration to the subject of the disposal of sewage and trade wastes in order to control river pollution. The disposal of liquid trade wastes is broadly governed by national legislation, under which local authorities have prepared detailed regulations to meet their peculiar conditions.

Acts of Parliament.—The Public Health Act of 1875 gives permission to manufacturers to discharge their liquid trade wastes into the local authorities' sewers, subject to compliance with conditions required by them relative to making the connection.

The Rivers Pollution Act of 1876 was primarily enacted to prevent the pollution of the rivers. This act confirms the permission given the manufacturers to discharge trade wastes into sewers by the former act, but also gives the local authorities the privilege of refusing to admit into their sewers "any liquid which would prejudicially affect such sewers, or the disposal by sale, application to land, or otherwise, of the sewage matter conveyed along such sewers."

The Public Health Acts Amendment Act of 1890 prohibits the discharge into any sewer of "any matter or substance by which the free flow of the sewage or surface or storm water may be interfered with or by which any such sewer or drain may be injured." It also prohibits the discharge into the sewers of any "chemical refuse or any waste steam, condensing water, heated water or other liquid (such water or other liquid being of a higher temperature than 110 deg. F.) which either alone or in combination with the sewage causes a nuisance or is dangerous or injurious to health."

These acts authorize the admission of trade wastes to the sewers providing they do not cause obstruction in the sewer, injure its fabric, prejudicially affect the disposal of the sewage, create nuisance or injure the public health.

REGULATIONS OF LOCAL AUTHORITIES

In some English cities certain industries have developed to such an extent that regulations in regard to the admission of trade wastes to the sewers are worded so as to meet the local needs and this should be considered in applying these regulations to other cities.

Accrington.—Wastes from breweries, leather curriers, chemical, print and dye, gas and soap works, wool washings and steam from boilers, are not admitted to the sewers.

Belfast.—Trade wastes liable to injure the sewers or workmen are not admitted.

Birmingham.—This city has the largest biological sewage treatment works in England, and John D. Watson, the engineer in charge of it, presented a paper before the Royal Sanitary Institute in 1910 on the trade waste problem, in which he stated:

> Theoretically a manufacturer should reckon the cost of disposing, effectually and legitimately, of all refuse or waste arising out of the manufacturing process adopted by him just as he would reckon upon disposing of residual products, if they were solids, as part of the cost of production, and I have great sympathy with those who contend that by allowing manufacturers to make use of the sewers for purely trade purposes an injustice to the general ratepayer is thereby created. Much could be said to support this view, especially in scattered urban and rural districts, where the admission of trade waste into a sewer may upset the whole systen in consequence of the increased volume in proportion to the volume of the domestic sewage of the district, or in consequence of the foul nature of the waste, or where a small sanitary authority has a sewage farm limited to the needs of a stationary population, the admission of trade waste into the sewers might be disastrous. The whole situation is fraught with difficulty, and I am satisfied that no cast-iron regulations will prove acceptable either to local authorities or manufacturers, as what is suitable for one place is not necessarily suitable for another.
>
> Speaking generally, manufacturers are not in possession of adequate facilities for getting rid of their liquid wastes. They should not only have the right of discharging it into the sewers, they should receive every encouragement to do so from the local authority, from riparian owners and from others interested in the purity of our streams, and I commend very heartily the recommendations of the Royal Commission on Sewage Disposal in regard to this. These recommendations are summarized under paragraph 335 of the fifth report; the two leading paragraphs are as follows:
>
> "We are, therefore, of opinion that the law should be altered so as to make it the duty of the local authority to provide such sewers as are necessary to carry trade effluents as well as domestic sewage, and that the manufacturer should be given the right, subject to the observance of certain safeguards, to discharge trade effluents into the sewers of the local authority if he wishes to do so.
>
> "We do not think it possible to provide, by direct enactment, what these safeguards should be. In each district it would probably be desirable that the local authority should frame regulations which should be subject to confirmation by central authority. In most cases, however, these regulations could provide definite standards for the different manufacturers as regards preliminary treatment, and it appears from the evidence that manufacturers would much prefer to have standards to work to."
>
> The Royal Commission were right in suggesting that manufacturers should have the right of discharging trade wastes into the sewers and it should be dealt with at the outfall works at the expense of the local authority, except in special cases where the local authority would be put to additional expense either in conveying the trade liquid to its ultimate point of discharge, or in purifying it when it arrived. Even if the recommendations of the Royal Commission were carried out, they are sufficiently elastic to allow each local authority to frame by-laws applicable to local circumstances, leaving the central authority to approve, or disapprove as they think fit.
>
> Personally, I deprecate tantalizing interference with manufacturers in the conduct of their business. During the initial stages it may be necessary to make analyses and take gagings before connections are made to the sewers, but these arrangements should be definite, and in giving effect to them as much latitude should be allowed to the manufacturer as is consistent with the well-being of the community. In taking this view, I am not insensible to the fact that by allowing the volume of trade waste to increase in greater proportion than domestic sewage (a circumstance that would be unavoidable in some cases) the difficulties of purification are accentuated, but I am convinced that the combination of trade waste and domestic sewage in most cases is capable of being dealt with more economically and more satisfactorily by the local authority at the outfall works, than when the domestic sewage is treated by itself, and each manufacturer compelled to purify the trade waste from his works on a plant designed for the purpose, and located within his own premises.
>
> Of course, it may pay some manufacturers to

recover their waste products, and if so it is better that they should do so, but if the value of the waste product should depreciate, the manufacturer might find it better to scrap his plant and make an arrangement with the local authority to treat the trade waste at the municipal works.

In the district represented by the Tame and Rea District Drainage Board *there is no by-law forbidding manufacturers to discharge their trade effluents into public sewers, and there is no special charge for treating effluents because of their especially noxious character.* The result of this generous treatment of the manufacturer is regarded by the board as being in the interests of the general community.

Where sewage effluents of this noxious character are discharged, and the consequences have been brought to the notice of the manufacturers, they have without compulsion, and in the absence of a formal by-law requiring them to do so, constructed duplicate tanks to obviate sudden discharges in bulk, and to provide for a regular and limited flow to the sewers.

Blackburn.—Spent hops are not admitted to the sewers, as they decrease the efficiency of sludge presses and oils and tar from gas works are prohibited, as they interfere with the filter beds.

Bolton.—They have no prohibition for trade wastes on account of their effect upon the treatment of the sewage, but the council were considering in 1912 requiring manufacturers paying a charge for the extra trouble of handling their trade wastes at the sewage treatment works.

Bradford.—This is a great center of the wool trade, and it is estimated that one-half the volume of the sewage consists of trade wastes. Due to the large amount of fat in the sewage from wool washing the sewage works are especially designed for grease recovery. Trade wastes deemed injurious to the sewers are not admitted. All new connections to the sewers are made subject to agreement; in some cases the manufacturer pays 2 to 3 pence per 1,000 gallons ($3.20 to $3.70 per million U. S. gallons).

Burnley.—Trade wastes injurious to the sewers or workmen are not admitted to the sewers. In certain cases, such as tanneries, print and dye works, etc., the manufacturer is charged a fee for the admission of the wastes. In such cases the agreement contains a clause allowing the corporation to terminate the agreement at any time on six months' notice. This precaution allows of a revision of fees from time to time.

Burton-upon-Trent.—The sewage treatment works are especially adapted to handle sewage containing brewery wastes, as brewing is the principal industry in Burton. Precautions are taken to exclude solids in the trade wastes as much as possible. Wastes injurious to the sewers are not admitted, specifically acids from chemical works.

Eccles.—The only restriction placed upon the admission of trade wastes to the sewers is that they shall not be discharged in bulk, but turned into a settling tank and allowed to discharge into the sewer gradually over the 24 hours. In 1910 the authorities made an investigation of the nature of the trade wastes admitted to the sewers and decided not to hamper any of the local industries by awkward restrictions and concluded it would be most advantageous to the interests of the borough to treat the trade wastes at the sewage disposal works at the cost of the whole of the rate-payers.

Glasgow.—Legislation is in force to prevent the admission to the sewers of such wastes as would injure the fabric of the sewer, impede the flow, be dangerous to workmen (such as steam or water above 110 deg. Fahr.) cause nuisance or lower the efficiency of sewage treatment works.

Also manufacturers are required to construct reservoirs on their own grounds to retain such wastes as are dangerous to the health of those living in the vicinity and to "use the best practical means to prevent noxious or offensive effluvia."

Heywood.—The following requirements are made in regard to admission of trade wastes: "Those injurious to the sewer system are prohibited, acid wastes should be neutralized, trade wastes must not contain more than 11 grams of fat per capita population, insoluble non-volatile solids not to exceed 15 grams per gallon, and temperature not to exceed 120 deg. Fahr.

Leeds.—Trade wastes detrimental to the sewers in injury to the fabric or impeding the free flow of sewage are prohibited; but they have no regulation to prevent admission of trade wastes because they would increase the cost of sewage treatment.

Mr. Hart, the sewerage engineer of Leeds, stated:

> We have about 91 settling tanks for preliminary treatment of manufacturing liquid trade wastes in operation on their premises and by agreement with same corporation 54 of these cases, being most important cases, are under corporation control in regulating the rate of flow into sewers. Last year 1212 visits were paid by my inspector to these plants, being an average of about one visit per plant per month. In the majority of cases screens and settling basins were considered sufficient, but in fell mongering, woolen cloth scouring and dyeing industries, we also stipulated that grease must be treated by sulphuric acid before being settled and screened.
>
> In England I am of the opinion in our densely populated manufacturing centers that it is a wise policy to admit trade wastes into sewers and that the requirements of authorities should be standardized and be made applicable universally in this country for each industry. I would also emphasize the importance of adding stringent prohibition of vapors and gaseous matter and of liquids which in combination with the liquid or sewage may or does cause nuisances or danger to persons in sewers or to injure fabric of sewers, hence causes explosions of petrol, oils, etc., of gas works being cases in point. I have had experience of serious damages arising from these suspected cases.

Leicester.—They have no local requirements in addition to the general acts of Parliament already given. Dye and wool scouring works are required to settle their wastes in a tank with a grid at the outlet.

London.—As London is the largest city in the world, and probably has industries of every kind and their regulations are quite voluminous, they are given verbatim as furnished by Sir Maurice Fitzmaurice, late chief engineer, London County Council. The General Powers Act of 1894 prohibits the discharge into the sewers of:

> Any solid matter, mud or refuse, except such as is contained in ordinary house sewage............ Council shall not be bound to proceed to recover any such penalty in any case where in their opinion, such matter can be received into the sewers without risk or cause of injury thereto or obstruction, therein, or of affecting the health of any person employed in the sewers or otherwise." In addition to the above "any chemical or manufacturing or trade or other refuse" (not being solid matter or refuse to which the preceding section applies) is prohibited.
>
> Any waste steam, condensing water, heated water or other liquid (such water or other liquid being of higher temperature than 110 deg. Fahr.); which either alone or in combination with other matter or liquid in a sewer may cause a nuisance or involve danger or risk of injury to the health of persons entering the sewers or be injurious to the structure or material of the sewers or works of the council is prohibited.
>
> In all cases where petroleum spirit is used or handled to any considerable extent, an intercepting chamber of approved pattern should be provided to prevent any spilled spirit from entering the drains. This discharge of petroleum, including petroleum oil, into the sewers, is prohibited by the Council under Section 10 of its General Powers Act 1894, Penalty for infringement. L 20.

In regard to slaughter houses, the requirements are under the by-law for slaughter houses in the County of London, as follows:

> Section 2:
>
> (d) Shall provide sufficient vessels or receptacles, properly constructed of galvanized iron or other non-absorbent material, and furnished with close fitting covers for the purpose of receiving and conveying from such slaughter-house all blood, manure, garbage, filth, or other refuse products of the slaughtering of any cattle.
>
> (e) Shall, as far as is reasonably practicable, cause all blood from any animal slaughtered to be caught and placed in such vessels or receptacles, and upon the completion of any slaughtering, cause all manure, garbage, filth, or any refuse residues from the animals slaughtered, to be forthwith placed in such vessels or receptacles, and shall not cause or suffer any such substance to enter any drain or sewer, or any inlet to any drain or sewer.
>
> (f) Shall cause every vessel or receptacle to be kept closed while containing any of the aforesaid substances.
>
> (g) Shall cause any such substances to be removed and conveyed from the premises in such closed receptacles.
>
> Section 4:
>
> (b) Shall cause the means of drainage provided in or upon the premises to be kept at all times in order.
>
> Section 11:
>
> (b) To be well paved upon a duly prepared foundation with a jointless flooring of granite cement concrete, or other suitable hard and impervious material having a proper slope towards a gully-hole; and he shall cause such gully-hole to communicate by an adequate drain of glazed stoneware pipes with the public sewer, and be trapped by an appropriate fixed trap, and be covered with a fixed wrought-iron grating, the bars of which shall not be more than ⅜ in. apart.

Sir Maurice Fitzmaurice expresses the opinion that "No exception should be taken to the discharge of trade effluents into the sewer, provided that the requirements (above mentioned) are not infringed."

Manchester.—The admission of trade wastes to the sewers is subject to the following requirements, and manufacturers are required to enter into a formal agreement with the local authorities to pass their wastes through settling tanks, and that the resulting effluent shall be made:

> (a) Free from solids in suspension beyond 15 grains to the gallon (214 parts per million).
>
> (b) Free from substance matter or thing which shall or may (either alone or in combination with other matter or liquid, or with ordinary sewage).
>
> (1) Be injurious to the structure of materials of the sewers or works of the corporation.
>
> (2) Be injurious to the sewers or the sewage therein.
>
> (3) Cause or create a nuisance either within or without the sewers and
>
> (4) Be dangerous or injurious to health either within or without the sewers.
>
> (c) Free from any substance matter or thing, the discharge of which into the sewers may contravene any public or local Act of Parliament or Rule of Law.

They also require that wastes shall not be discharged in large quantities at irregular intervals, but at a uniform rate throughout the day.

Dr. Gilbert J. Fowler, consulting chemist to the Rivers Department, furnished the following information:

> The subject is a very large one and conditions differ in different towns. In Manchester it has been found that if the manufacturers put in equalizing tanks to regulate the flow and retain the solids, and if means are employed to obviate the discharge of acids or noxious gases and hot liquids, there is not much cause for complaint. Ammonia recovery liquor is rather an exception, but that is a somewhat special subject.

Rochdale.—Prior to connecting to the sewers manufacturers are required to make application to the County Court. Before the application is heard an understanding is come to with the corporation as to the necessary works and the courts order accordingly. If the manufacturer defaults the order is cancelled.

Salford.—At the present time there appears to be no need for restrictions, but the authorities are trying to induce certain manufacturers to install settling tanks for removing solids from waste lime, starch, dyeing materials, etc. The sludge from such tanks can be taken to the municipal sewage treatment works for conveyance to sea by the city along with sewage sludge.

Sheffield.—Trade wastes injurious to the sewers, such as hydrochloric, nitric or similar acids, steam, etc., are prohibited from entering the sewers. They have no trade wastes which they believe are detrimental to sewage treatment.

Wakefield.—Manufacturers are required to remove from their trade waste anything which will interfere with the treatment of the sewage. Dr. H. MacLean Wilson, chief inspector of the West Riding of Yorkshire Rivers Board, stated:

> I would give as my own personal opinion that it is far better and more economical for trade refuse to be received into public sewers under due regulation and to be treated along with domestic sewage

Substances Excluded from Sewer System in American and Canadian Cities

City or Town	Population	Substances Injurious to Sewer System																												Substances Detrimental to Sewage Disposal																	Substances Dangerous to Workmen																	Remarks
		Acids	Brewery Waste	Cinders	Clam Shells	Cotton	Crude Oil	Dead Animals	Fruit	Garbage	Hair	Limed Hair	Manufactory Waste	Marble Dust	Newspaper	Night Soil	Offal	Oyster Shells	Rags	Refuse	Shavings	Solid Matter	Sticks	Straw	Strings	Tree Trimmings	Vegetables	Vegetable Peelings	Wool	Ammonical Liquors	Any Foul Liquids	Bleach Liquors	Decaying Matter	Distillery Waste	Gas House Waste	Grease	Hat Felt	Heavy Oils	Kraut Sewage	Laundry Soap	Meat Brine	Oil	Packing House Waste	Tannery Waste	Tar	Wool Washings	Acetylene Gas Waste	Benzine	Exhaust of Gas Eng.	Gasoline	Garage Waste	Hot Gases	Liquids Above 110 F.	Steam, Exhaust	Steam, Live	Steam	Hot Water	Water Above 110 F.	Water Above 140 F.	Water Above 150 F.	Cess Pool Drainage	Cistern Drainage	Privy Vault Drainage	
Philadelphia, Pa.	1,600,000		⊛					⊛		⊛			⊛	⊛			⊛					⊛																																									⊛	Obstructions excluded
Atlanta, Ga.	134,800	⊛																																	⊛							⊛																						Disposal works
Amsterdam, N. Y.	31,300																																																						⊛										
Baltimore, Md.	558,500							⊛		⊛	⊛	⊛	⊛									⊛									⊛			⊛																				⊛	⊛	⊛								Disposal works
Birmingham, Ala.	132,700					⊛			⊛		⊛				⊛				⊛			⊛					⊛	⊛																																				
Bridgeport, Conn.	102,100							⊛		⊛							⊛																	⊛																														
Canton, Ohio	50,300	⊛																																																	⊛													Disposal works
Chambersburg, Pa.	11,800										⊛								⊛																																													Disposal works
Charlestown, S. C.	58,900																					⊛																																		⊛	⊛				⊛	⊛	⊛	
Chicago, Ill.	2,200,000							⊛		⊛							⊛					⊛																																		⊛								Drainage canal
Cleveland, Ohio	560,700							⊛		⊛												⊛																												⊛	⊛			⊛										
Columbia, S. C.	26,313	⊛																				⊛																												⊛	⊛			⊛										Disposal works
Columbus, Ohio	181,600																																																															
Concord, Mass.	21,500																					⊛														⊛															⊛													No factories
Clyde, Ohio	2,600																																						⊛																									Disposal works
Delaware, Ohio	10,000																			⊛		⊛						⊛																																				
Erie, Pa.	66,600																																																							⊛								
Fresno, Cal.	25,000						⊛																																																									
Gloversville, N. Y.	20,700											⊛										⊛																						⊛																				Settling tanks req.
Hartford, Conn.	98,900																																															⊛		⊛	⊛					⊛								
Kansas City, Mo.	248,400																		⊛		⊛	⊛	⊛				⊛																									⊛				⊛	⊛							
La Porte, Ind.	10,500	⊛																				⊛																																										
Lethbridge, Can.	14,000			⊛				⊛		⊛							⊛		⊛																																					⊛	⊛				⊛	⊛	⊛	Disposal works
Little Falls, N. Y.	12,300																⊛																			⊛																		⊛								⊛		
Marion, Ohio	18,200	⊛																																		⊛		⊛		⊛																								Disposal works
New Bedford, Mass.	96,700																															⊛								⊛																⊛								
New Haven, Conn.	133,700																					⊛													⊛																⊛		⊛			⊛			⊛		⊛		⊛	
Newport, R. I.	27,200																																			⊛															⊛													Automobiles
New Orleans, La.	339,100																																	⊛	⊛																		⊛			⊛	⊛				⊛	⊛	⊛	
Newton, Mass.	40,000																																																							⊛				⊛	⊛			
Oberlin, Ohio	4,200																																		⊛																													
Pawtucket, R. I.	51,700																					⊛											⊛								⊛														⊛									Disposal works
Pittsburgh, Kan.	14,700			⊛		⊛			⊛	⊛							⊛		⊛	⊛		⊛					⊛	⊛							⊛																			⊛								⊛		Packing houses
Plainfield, N. J.	20,600																					⊛																																										No factories
Providence, R. I.	224,400																					⊛																										⊛		⊛						⊛	⊛		⊛					Disposal works
Reading, Pa.	96,100																⊛																				⊛																											Disposal works
Salt Lake City, Utah	92,800	⊛								⊛						⊛						⊛														⊛				⊛		⊛								⊛						⊛								
Seattle, Wash.	237,200							⊛		⊛												⊛														⊛																				⊛	⊛							
Springfield, Mass.	88,900																																			⊛													⊛					⊛	⊛		⊛		⊛					
Southbridge, Mass.	12,600			⊛	⊛																	⊛	⊛	⊛																														⊛	⊛	⊛								Factory inspection
Spencer, Mass.	6,800																																		⊛																													Disposal works
Spokane, Wash.	104,500																					⊛														⊛							⊛																					Few factories
St. Boniface, Can.	10,000																⊛		⊛			⊛																																		⊛	⊛							Disposal works
Tallahassee, Fla.	3,000																⊛										⊛	⊛								⊛																												
Toronto, Can.	208,100																⊛																			⊛						⊛			⊛											⊛				⊛				
Washington, D. C.	333,100			⊛		⊛									⊛							⊛	⊛	⊛	⊛	⊛				⊛					⊛							⊛			⊛			⊛		⊛			⊛			⊛	⊛							
Waterbury, Conn.	73,200	⊛																																																					⊛									
Watertown, N. Y.	26,800																					⊛																																										
Wilmington, Del.	87,500			⊛						⊛							⊛		⊛			⊛						⊛																												⊛								
Winnipeg, Can.	42,400																⊛																														⊛																	
Worcester, Mass.	146,000	⊛		⊛	⊛						⊛											⊛	⊛													⊛																		⊛	⊛	⊛			⊛					Disposal works

of the town, than that each factory should have its purification works. The economy of this method of dealing with the refuse will be evident on consideration of the saving in initial cost and upkeep of individual plants, and it is our experience here and particularly on Batley Beck that it is impossible to ensure that effective treatment will be kept up in each case where there are a large number of factories with their own purification works. With regard to the charge (required by the authorities for the admission of trade wastes) it should only be made when the manufacturers do not adopt some preliminary treatment of their refuse, but the idea seems now to be gaining ground that every manufacturer should pay to the town authority the full amount which the treatment of his trade waste cost.

Wolverhampton.—A clause in the local improvement act prohibits the discharge of matters injurious to the sewers, such as waste wash-water from galvanizing works, refuse from tar distilleries, breweries, color, paint and varnish works.

LEGISLATION IN HAMBURG, GERMANY

Herr Ferdinand Sperber, Baudirector of Hamburg, stated:

In Hamburg, as in the whole German Empire, the operation of certain kinds of factories requires a permit, according to par. 16 of the Imperial Industrial Regulations. For the most part factories with dangerous sewage also come under par. 16, so that at the time of issuing the permit for these operations definite assessments for handling the dangerous sewage may be made before conveying same into the public sewers.

Naturally it happens that in spite of that fact, untreated industrial sewages, and especially diluted acids, are conveyed into sewers. According to the experience on this side the conveyance of such sewages is mainly a danger for the workmen engaged in sewer operations, while damages to the sewers due to same are hardly known. It must be added, however, that the Hamburg sewers are made out of the best glazed stoneware pipes (in contrast to the ordinary cement pipes) and out of only well-baked bricks which are walled up in cement mortar.

Sewage purification plants, especially biological establishments, must in the interest of the community naturally be protected against the introduction of sewages of single operations, which might damage the whole method of operating the plant. The provisions referring to this, which have been issued for Bergedorf, for example, for the protection of the Hamburg biological sewage purification plant, are herewith enclosed.

In the interests of industry provisions for the preliminary treatment and exclusion of sewages are naturally to be thoroughly tested in the different cases, as it may well happen that two sewages coming from different operations, which would in themselves be injurious, are, however, neutralized in the preliminary purification tanks of the sewage purification plant and in this way become harmless for the operation.

The industries which are mentioned in paragraph 16 of the Imperial Industrial Regulations are: Plants for distilling petroleum, plants for preparing coal-tar from brown and black coal, all sorts of chemical factories, chemical bleaching, starch factories, glue, fish oil and soap boilers, bone-burners, bone-driers, bone-boilers, bone-bleachers, tallow-renderers, abbatoirs, tanneries, flaying-houses, fertilizer factories, spent fish-oil factories, plants for distillation or elaboration of tar, plants in which pulp is made from wood or other similar fibrous material in a chemical manner, establishments for drying and salting untanned animal hides and galvanizing plants.

BERGEDORF REGULATIONS

The provisions governing these industries in the Bergedorf are as follows:

Industrial plants whose sewage is capable of endangering or damaging the sewers and sewage purification plants, on account of its abundance or character may be refused connection to the sewers by the community of Bergedorf, or, as far as possible, permitted under special provisions to be fixed according to conditions, in agreement with the Board of Health, the industrial inspectors and the building commission, department of sewers. A special tax corresponding to the amount of sewage may be imposed for the cost of operation, and also the obligation to make good any damage caused by the handling of this sewage. The prohibition of the connections being made or limitations or restrictions to be imposed shall be incorporated in the permit record, in the case of a plant to receive a permit from the police in accordance with industrial orders paragraphs 16 and 25. In the case of plants not subject to permit from the police on industrial matters the limitations and restrictions that may be required shall be designated by the community authorities in agreement with the above-mentioned departments and shall be turned over to the entrepreneur as conditions when the building-police issue the permit to operate the plant. In all cases the right is reserved to change or add to these conditions.

Connection shall not be denied or refused to those industrial plants now connected or once connected to the sewer-system, as long as the prescribed conditions, or those that may be prescribed, as regards the character of the sewage or its purification are held to and as long as no marked change is apparent in the character or quantity of the sewage.

REGULATIONS IN UNITED STATES

The table given shows the regulations in force concerning substances not admitted to the sewers in several American cities, in addition to which the following data were obtained:

Atlanta, Ga.—Permits for sewer connections from industrial establishments are only granted after an examination of the plant by the city authorities, and a decision reached that the wastes are suitable for admission.

Gloversville, N. Y.—The principal industry of Gloversville is leather tanning, and a city ordinance requires the factories to construct and maintain proper tanks for the settlement of the trade wastes prior to its admission to the sewers.

Reading, Pa.—Before the construction of the present sewage treatment works it was recommended that gas house wastes should be treated by the company producing them, and that wastes from hat factories should be screened or settled to remove fibers.

Syracuse, N. Y.—The officials of this city believe that certain trade wastes of that city which are antiseptic should be excluded from the sewers.

Worcester, Mass.—Due to trade wastes the sewage of this city has an acid reaction and the sewage treatment works are designed and operated to meet this special condition, the policy of the officials being that as industry is the life of the city the municipality should pay the extra cost of special treatment of the sewage.

In a paper presented to the Engineers' Club of Pennsylvania, June 10, 1909, Frank A. Barbour stated that trade wastes should be treated prior to discharge into sewers so that suspended solids should be reduced to 300 parts per million and the fats to 200 parts per million; that abnormal acidity or alkalinity should be neutralized and pronounced antiseptic properties removed, and that provision should be made for approximate uniform discharge. He also suggests that analysis of the various constituents of trade wastes may show that some can be discharged directly and only a part may require treatment.

CONCLUSION

Trade wastes having the following characteristics should not be admitted to the sewers without sufficient treatment by the producer to remove the objectionable features:

1. Containing substances which will form deposits in the sewers or adhere to the interior surfaces.
2. Containing inflammable substances.
3. Steam or excessively hot liquids.
4. Acids of sufficient strength and volume to injure the fabric of the sewer.
5. Containing substances which will seriously interfere with the operation of a sewage treatment works.

The admission to the sewer system of trade wastes which would increase the cost or decrease the efficiency of sewage treatment is a matter of policy to be determined by the local conditions. In some cases it may be advisable to encourage industry by the municipality paying the increased cost at the sewage treatment works. In other cases a fee may be charged for the admission of such wastes, and under certain conditions it may be advisable to require the producer to remove the objectionable characteristics by partial treatment before discharge.

In framing legislation to meet these requirements it is advisable to secure to the municipality the right of entry upon manufacturers' premises and to require the producer of trade wastes to show the inspectors what is done with the wastes rather than to require them to collect evidence which is frequently very difficult to obtain in a sufficiently definite form for presentation in court, if that proceeding becomes necessary.

Rectangular Fire-Service Reservoir

Auxiliary Structure Built above Ground, Fed by 8-Inch Artesian Well

By W. G. POTTER
Engineer, Department of Water and Sewer Improvement, Aberdeen, S. D.

IMPROVEMENT of the water supply system, costing $35,000, involving the construction of a rectangular reinforced-concrete reservoir, fed by an incased artesian well, 1275 ft. deep, has been completed in Aberdeen, S. D., a town of about 12,000 population. Located on flat prairie land, the variation in elevation over the entire town is little more than 10 ft. It has no available streams suitable for either water supply or sewage disposal, but is fortunate in being situated in the artesian belt of South Dakota.

The artesian flow is found at two levels, one about 1000 ft., the other about 1270 ft. deep. The first flow was originally strong, but so many private wells have been driven to it both in the city and on the farms through the surrounding region, and the waste is so great that the pressure is gradually diminishing. The lower flow, however, has been used comparatively little except by the city, and no diminution in volume or pressure has yet developed. The city water supply is derived from six wells to this flow, and for domestic purposes the supply is ordinarily ample. One 8-in. well alone has a flow of 2300 gal. per minute, with a hydrostatic pressure of over 200 lb.

The distribution system, however, is mostly of small pipe, involving large frictional losses, and in case of fire or of the heavy drain of the summer sprinkling hours, the supply is not ample to maintain the pressure for any great length of time. The writer was retained to design and construct a reserve storage, to be used only in case of low pressure.

It was, of course, desirable to utilize as much as possible the natural pressure for all ordinary domestic service. The usual hydrant pressure, direct from wells, is 40 to 60 lb., at night occasionally running up nearly to 100 lb., so that the new system will provide altogether for a reserve or "booster" supply. On account of the extreme climate in the winter, and of the large size, cost, etc., of a steel stand-pipe, that type was rejected in favor of a large concrete reservoir, supplied by an independent well.

RESERVOIR ABOVE GROUND

This is a cased well 1275 ft. deep, 8 in. in diameter through the surface flow, below which it is 6 in. Its flow is about 1200 gal.

per minute, with a hydrostatic pressure of about 200 lb. Because of the extreme shallowness of the storm sewer at this point, the enclosing reservoir, which is from 23 to 24 ft. high, is only about 5 ft. in the ground, a filled berm rising 10 ft. above the ground. The reservoir is rectangular, 80 x 100 ft. divided into two compartments, each holding 600,000 gal. The outside walls are 12 in. thick at top and 24 in. at bottom and are strengthened by pilasters tapering from 6 in. to 24 in., spaced 10 ft. The center wall is 12 in. thick at top and 30 in. at bottom. The roof is a 4-in. slab resting on 12 x 16-in. beams, supported by 18-in. square piers, spaced 20 ft.

With the exception of the floor, which is 8 in. thick and of a 1:5 mix, the structure is built of 1:4½ gravel concrete. Although the gravel, which was taken from Lake Kampeska, below the water level, is very fine, it is remarkably clean and, after screening, formed a dense, solid concrete. The entire structure is heavily reinforced with square cold-twisted bars of the W. B. Hough Company make. The total weight of reinforcement, including the wire mesh in the roof slab, is more than 50 tons.

OPERATION

Water enters each half of the reservoir through an 8-in. main running from the well along the floor nearly the full length of the tank, with openings at various points to distribute the inflow. Two 16-in. suction pipes lead to the pumps, which are connected with the city mains. At the maximum flow line, a reinforced overflow trough extends the full length on each side of the middle wall, leading through the wall at one end and then down to the storm sewer. In service the water is kept at a slight overflow in each compartment all the time in order to insure it against freezing and possible stagnation. The quantity not needed to maintain this overflow is turned directly from the well into the city mains, to increase the usual pressure. Water may thus go to the reservoir, to the mains direct, to the sewer or to all of these at the same time.

THE COVERED RESERVOIR IS DIVIDED INTO TWO 600,000-GALLON COMPARTMENTS

An 8-in. cleanout is also arranged in each compartment with gates outside, by which either half may be emptied while the other half is maintained ready for service. The inner surface of the reservoir was plastered with cement plaster and then painted with several coats of asphalt paint.

The pump house, of brick and tile construction, 37 x 20 ft. inside, consists of a main room and three small rooms—for coal, oil and office. The coal used is merely for heating the building during cold weather. Three two-stage centrifugal pumps, each with a capacity of 1000 gal. per minute at 100 lb. pressure, constitute the equipment. Each is operated by a 2200-volt alternating-current motor.

Power for the pump house is furnished by the local light and power company over two independent circuits. It is proposed to run one or two of the pumps ordinarily, keeping the third in reserve for possible breakdown or emergency. Two pumps will furnish 2000 gal. per minute at 100 lb. pressure at the pumps, or at about 80 lb. anywhere in the fire limits.

The cost of the entire improvement was about $35,000, divided as follows: Artesian well, $5800; reservoir complete, with piping, gates, etc., $19,000; pump house complete, $8600; 12-in. and 16-in. mains connecting the reservoir with the larger distributing mains of the city, $1600.

Municipal forces performed the entire work of the improvement, being aided in the work by the helpful policy of the city commission.

Deficiency in Personality Responsible for Engineer's Failure to Receive Recognition

Professor Swain States Qualities Necessary for Leadership and Compares Engineer's Fitness with That of Lawyers and Business Men

HOLDING that if engineers do not receive proper recognition for their ability, there are natural and ascertainable reasons, Prof. George F. Swain, of Harvard University, in an address before the American Institute of Electrical Engineers, on Feb. 17, found that, on the whole, engineers are deficient in clarity of thinking as compared with lawyers, and in both clarity of thinking and breadth of view as compared with lawyers and business men. These prime qualifications for leadership are but two of many essentials—all of which can be included in the words "knowledge" and "personal qualities." Other personal qualities he considered necessary were character, presence, tact and ability to handle men.

While he conceded that these qualities are to some extent inherent, he believed that, more or less, they were susceptible of development, and he, therefore, urged that engineers use their influence to have engineering curricula changed so as to place greater emphasis on fundamentals, and to have the young men broaden their horizon by taking an interest in history, literature, psychology and other lines which give a grasp on the problems of life. He believed, too, that efforts should be made to present the advantages of an engineering career to the ablest of our young men so that more of them would go into engineering instead of into law, as they do now.

Professor Swain spoke as follows:

WHY THE ENGINEER FAILS OF RECOGNITION

It is an opinion that is very widely held, and particularly among engineers, that the engineering profession is not appreciated at its full value, and that the engineer does not receive the recognition in public life and as a leader that his attainments entitle him to receive. In times past I have not hesitated on various occasions to raise my voice, feeble though it may be, in support of that proposition. I have not changed my views at all. However, it seems to me that possibly by emphasizing it continually, we may overdo a little bit that aspect of the matter, and I am, therefore, going to ask you tonight to take a different point of view with me, and to inquire, if the engineer has not his recognition, what the causes for it are, and how they may be remedied.

Of course, as a purely professional worker, the engineer is always necessary and will always be called upon to do engineering work. Moreover, statistics show that the remuneration which engineers receive is as large as that received by members of the other professions, on the average. It is a question of supply and demand, and the engineering profession is not overcrowded. I feel certain of this from my experience in having turned out a great many young men year after year, and having placed them in positions.

MONEY AND HAPPINESS

Moreover, happiness and content, real success, service to mankind and to a man's family, do not depend upon money, and are not measured by dollars and cents; they can be obtained just as well when the remuneration is moderate as when the remuneration is very large, and engineers, as a rule I believe, receive compensation sufficient to enable them to live comfortably.

In my opinion, in recent years the respect paid to the engineer, if measured by financial remuneration, has increased, and engineers now frequently receive very large fees, fees that 25 or 30 years ago would have been considered almost out of the question. However, those fees are not as large as those received by lawyers or doctors, of course, for the reason that the engineer does not appeal to sentiment, which is so potent a factor in the other professions. I presume that fear, love and avarice are the most potent emotions. The law appeals to all of them. Medicine appeals to fear and love. Engineering appeals to none of them. Another potent factor in the human being is vanity. Architecture appeals to vanity. The architect can easily convince his client to put up a costly and luxurious building, upon which he receives his percentage, the percentage increasing as the work is less and less necessary. (Laughter.) The architect rightly puts a tax on luxury.

However, these matters will take care of themselves. We are chiefly concerned here with the status of the engineer as a leader in the community, as a moving force, as an administrator or executor, who leads in the solution of great problems.

QUALITIES FOR LEADERSHIP

The suitability of a man for leadership depends upon two things—his knowledge and his personal qualities. Most of the great undertakings today involve engineering; most of them, to a very great extent. We recognize this. We know that we live in an age of applied science.

Law and business are equally necessary in the solution of these undertakings. There is no more reason, inherently, and no less reason, why the engineer should lead and be the employer any more than why the lawyer or the business man should lead and be the employer. It gets down, therefore, in the end, to the matter of personal characteristics. The lawyer or business man with personality can easily lead, and can hire the engineering brains and knowledge, just as the engineer, if he have the personality, can lead and can hire the legal and the business brains and knowledge.

If, therefore, the engineer does not lead, it must be because he lacks personal qualities, and if he lack the personal qualities, he ought not to lead. There is no mystery about it, no injustice. By personal qualities I mean character, presence, tact, ability to handle men, breadth of mental vision, mental training.

Some of these qualities are inherent, and others are developed, more or less, by training and experience. There is no reason to believe or to assume that one class of men in the same country and at the same epoch are inherently superior in regard to personal qualities to any other class. Have we any reason to suppose that the engineers are inherently superior to the members of other classes in this country? It does not seem to me that we have. What indications there are might be considered to point the other way.

BEST MEN TAKE UP LAW

This is a matter upon which a person cannot speak at all positively or dogmatically, but I have talked with a good many college graduates as to what becomes of the men in their classes, and I have been rather interested to find that they almost all tell me that the ablest men in their classes go into law or into business. One thing, therefore, we must do is to induce young men of ability and character to become interested in engineering and embrace it as a profession. We can all of us do something in that direction.

The problem is then reduced to this further question, whether the personal qualities that come by training, or are developed by training and experience, give to engineers, to the engineering profession, pre-eminent qualifications for leadership. Those qualities which are influenced by training and experience are mental grasp, ability to reason, capacity to discern truth, desire for truth, and ability to deal with the human element. It is generally claimed that the engineer should be particularly fitted, not only by his knowledge, which matter I have already referred to and disposed of, but by his training, making him able to think straight, to have a breadth of view to discern the truth, a desire to get at the truth, and the ability to know the truth when he has got at it.

DO ENGINEERS THINK STRAIGHTER THAN LAWYERS OR BUSINESS MEN?

Now, how true are these claims? Do engineers think straighter than lawyers or business men? No positive statements can be made. Of course, I am speaking generally, and there are exceptions to any statement that can be made, but I doubt whether engineers as a class think straighter than lawyers, especially, or the well trained and experienced business man. The training of the lawyer in the exact meaning of terms is one of the most important factors in making him think straight. We all know that misunderstandings and errors in reasoning come about because the exact meanings of the words or terms we use are not understood. The lawyer is continually concerned with getting at the exact meaning of words. In drafting statutes, in drawing wills, in all his varied work, that is one of the practical courses of discipline which he goes through and there could be no better discipline.

Moreover, no man understands a question if he can only state it from the positive point of view, he must also be able to state it from the negative point of view; he must see not only what it includes, but what it excludes; he must see not only the arguments in favor of it, but the arguments against it. In that matter, the lawyer has a most excellent training. When he assumes a case he puts himself in the position of his adversary and exerts his wits to the utmost to discover the weak points in his own case. He tries to discover every argument that can be brought up on the other side, and then prepares himself to meet it. I somewhat question if engineers in their experience go through quite as good a mental discipline as that, or whether in the schoolroom they get anything that is quite as good a mental discipline.

I think, therefore, that the legal training and experience, on the whole, train men better to think straight and reason logically than the engineering training. The single objection to the legal training is that the lawyer is apt to become an advocate. But still we all know that there are many, very many, capable, high-minded lawyers who will not take a case unless they believe that they have the right.

BREADTH OF VIEW

Now, how about breadth of view? Can we say that the engineer's training and experience give him greater grasp of subjects and greater breadth of view than those of the lawyer or the business man? Here again there may be doubt, but I similarly question whether today, and in the past, the training of the engineer has given him as much a grasp of subjects and a breadth of view as the training of the lawyer and the business man. I fear that the engineer concerns himself in college, and after college, too much with the minor technical details of his profession, and does not accustom himself to study, does not take interest enough in the consideration of the broad questions affecting the community in general. I know that is so in the colleges. I know that the young men get interested in the purely technical details, and that it is very difficult to get their minds away from these things to any large extent.

I am a great believer in the business man, and I believe that his experience, bringing him in contact, as it does, with law, with engineering, with all the varied activities of life, is a very excellent training. I should like to see more engineers in Congress, I should like to see an engineer become the President of the United States, but I should like to see, for once, a really good business man in the presidential chair. (Applause.)

Instead of complaining, then, although it is true, that the engineer is not recognized, I urge that we try to realize that there is a cause for it. We live in a world of natural law. For everything that is, there is a cause, not only in the physical world, but in the mental and the moral. Let us find the cause, if the engineer be not recognized and the remedy.

Among the things I think we can do are the following: We can exercise our influence to bring the facts in regard to the engineering profession, its possibilities, the high character of its work, to the attention of our students and to induce the able young men of the coming generation to embrace the engineering profession. In the second place, we may influence technical education and try to secure a broader curriculum, with more attention to fundamental principles and less to technical details which the graduate must learn in the field after he graduates and which he can learn a great deal better there than in school. Let us insist on a training in the English language, so that our engineers shall not only be able to speak and express themselves properly, but be able to write a proper report, and therefore impress upon people with whom they come in contact that not only are they qualified in their engineering specialty, but that they are able to mix with men and deal with large questions in a comprehensive way.

NARROWING TENDENCY OF MATHEMATICS

I agree entirely with what has been said in regard to mathematics. I think the fact that engineering is to so large an extent a mathematical subject is one of the main reasons why the engineer is not recognized. In my opinion, there is scarcely anything that tends more to narrowness of view than dealing all the time with problems that can be solved only by rigid mathematical processes, because the great questions which confront us are not mathematical; the data are shifting, variable, and the human element comes in. Therefore, the man who is accustomed to solve his problems by mathematics, and can only do the solving in that way, finds himself at a loss in the practical affairs of life—mathematics do not apply. We should seek to broaden the minds of our engineering students by study in history, literature, psychology and other subjects which give a broad outlook upon life.

I urge, therefore, that in these ways we help to give the engineer of the future the personal qualities for leadership. We may rest assured that if he is possessed of these qualities, leadership will come to him.

LIMITING THE SIZE OF HEAVY MOTOR TRUCKS and their loads, an ordinance recently formulated by the city of Chicago law department provides among its restrictions that all trucks shall have rubber tires overlapping steel tires; that the weight of vehicle and load shall not exceed 750 lb. for each inch of tire width, the maximum weight allowed being 28,000 lb.; that for freight-carrying purposes no truck shall be more than 90 in. wide or 26 ft. long, and that for passenger-carrying purposes, 8½ ft. should be the maximum width. Speed of trucks is to be based on capacity and will range from 6 to 12 mi. an hour. Loads shall not project more than 4 ft. past the rear end of the truck, except during early morning hours and late at night. The ordinance has been presented to the city council judiciary committee, and a copy, to the local transportation committee.

Microscope as a Check on Construction

Fourth in a Series of Six Articles—Demonstrating the Quantitative Mechanical Analysis of New or Old Concretes

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IN ANY examination of concrete constructions where the quality of the product may be in doubt, the detection and localization of serious defects are matters of prime importance. In preceding papers certain imperfections as revealed by microscopic examination of typical samples of the mixture have been dealt with. In this article the detection of weak and faulty mixtures, resulting from either dishonesty or carelessness in field mixing, will be considered, with special reference to their bearing on the failure of completed structures.

Control Needed

The more the import of even a single failure is considered, the more desirable it seems that some means of controlling the product should be at hand during the making of concrete, instead of waiting until it is too late before serious defects at critical points are detected. Further, in case the work is done under contract and there should be suspicion that materials were being used in improper proportions, as, for instance, too great a quantity of aggregate for the quantity of cement, it is very desirable that some means other than a tally of empty cement sacks be available to decide the disputed point. Or, in case of the collapse of a concrete structure, it is highly advantageous in the determination of causes that the proportions and quality of the set concrete should be known, independently of the specifications that were supposed to govern its building, or of the honest beliefs of the constructor, for specifications usually are interpreted generously, and all mankind is prone to inadvertent error. Many other uses suggest themselves for a reliable, simple method of analysis, which will be applicable either to old or new concretes, according to the needs of individual cases.

It requires but a little reflection to see that a variation of the same sort of microscopic examination that has previously been demonstrated will furnish not only the desired check on construction, both in materials and methods, but also the means for a quantitative analysis of practically any concrete of any age. In the latter application, it is necessary at the outset to make certain assumptions, but if they are proved correct by the results of the actual analysis, they may be considered to be justified.

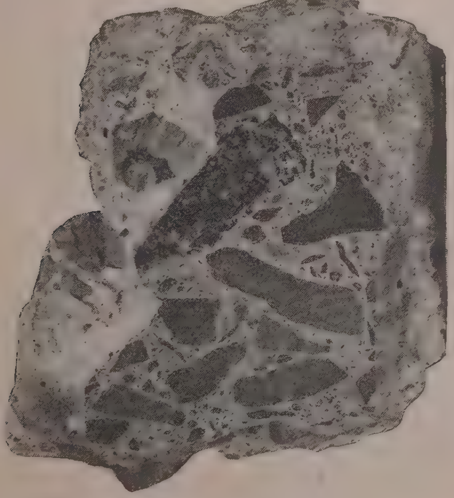


FIG. 16—SURFACED SPECIMEN OF CONCRETE
One-fourth Natural Size

Assumptions Made

In Article 1 of this series, a surfaced section of a field concrete was shown, and the structure of this section was held to be representative of the structure of the entire mass, on the ground that it was a random section. In the micro-photographs of mortars in Article 1 and in the articles following, the same assumption was made, and it is fair to assume that this is correct, provided other sections from different parts of the same structure are examined without showing too great a variation. Experience seems to demonstrate that where proper care in mixing and placing has been exercised, there is but slight variation in sections from different portions of any given structure. This applies equally to gross and to micro-structures. On the other hand, where carelessness has prevailed, sections are quite dissimilar, so that a sufficient number of samples must be sectioned to get a proper average. The obtaining of representative data is a first principle in any work.

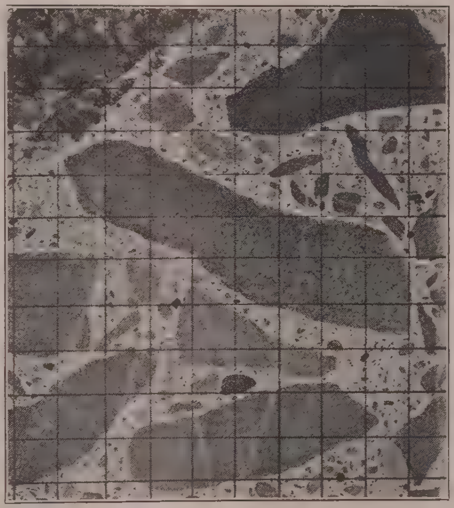


FIG. 17—PHOTO OF SPECIMEN CROSS-RULED
One-half Natural Size

Granting, however, that representative samples are obtained, and that the random surfaces are typical of the mass, it is then necessary to make the further assumption that areas are equivalent to volumes, both as regards the large aggregate, the small aggregate and the cement, both hydrated and unhydrated. It is evident that this must be true if the first assumption is correct, i. e., that the surfaces obtained are typical of the structure of the mass. And if this second assumption is true, it is possible to obtain in a gross section the ratio of volume of [large aggregate] to volume of [sand + (cement + water + air)] and in a small section, containing no large aggregate, it is possible to obtain, by using the microscope to give an enlarged image, the ratio of the volume of [sand] to volume of [cement + water + air]. This is the basis of this method of analysis.

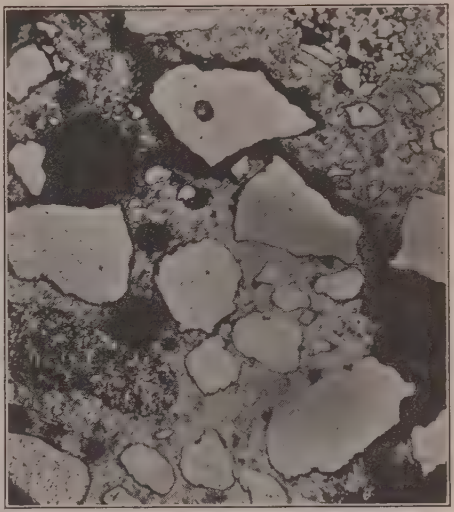


FIG. 18—PHOTO-MICROGRAPH OF SPECIMEN OF FIG. 17
Enlarged to 20 Diameters

Analysis Demonstrated

In order to demonstrate the correctness of these assumptions by the working out of the analysis, it will be simplest to use a laboratory-mixed concrete for a trial.

Fig. 16 shows a sectioned lump of such a concrete about 8 in. on a side and weighing about 10 lb. This cut is about one-quarter natural size. The characteristic wide dispersion of aggregate, which has become familiar in the examination of other concretes, is evident at first glance.

Fig. 17 shows a portion of the same section, enlarged to half natural size. Even the smaller aggregates are plainly seen. It will be noted that these smaller grains, also, are out of contact with each other. Evidently any void determinations that were made on these aggregates would most certainly be wide of the mark, so far as the present inter-aggregate volumes are concerned.

In Fig. 18 a magnified portion of the same surface is shown photographed through the microscope. All of the large aggregate has been excluded, as even a portion of one of the larger pieces would completely cover the field. The "rocks" showing in this picture are sand grains, as has before been pointed out. Characteristically, even the smallest of these are widely dispersed, with large lumps, or groups of particles, which are unhydrated cement, lying between them just as in other concretes that have been previously examined. These features have doubtless long since become so familiar to readers of this series as to be instantly recognized.

Determining Areas

Evidently, by means of magnifying with the microscope, even the smallest kind of sand grains may be rendered not only distinctly visible, but as of such size that their areas can be determined by appropriate means; and going a step further, the ratio of their combined areas to the area of the total field can be had by simple addition. Further, when this addition is completed,

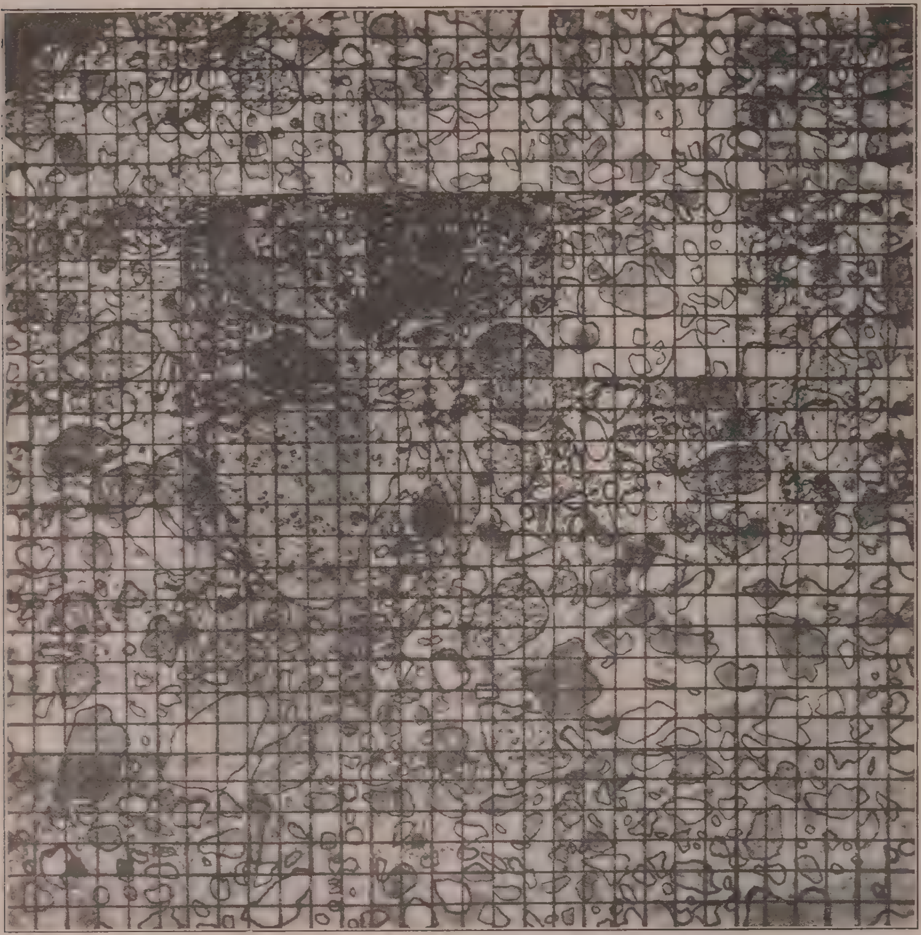


FIG. 19—COMPOSITE PHOTOGRAPH FOR DETERMINING SAND VOLUMES; 23 DIAMETERS

subtraction of sand areas from the total area of the field (a convenient circle) will give the area taken up by [cement (hydrated or unhydrated) + water + air]. Or calling areas equal to volumes in each case, this arithmetic gives directly the ratio of [sand] volume to [cement + water + air] volume. Ratios determined in this manner for a number of fields sufficient to give a fair average, should give, as an average, the true ratio of the volume of [sand] to the volume of [cement + water + air] in any concrete.

To take the actual case: As the simplest way of determining areas, rule the surface of Fig. 17 into small squares. By counting the squares taken up by the stones and deducting from the total number of squares, the ratio of volume of [stone] to the volume of [sand + (cement + water + air)] should be obtained. This is found to be as 67 to 144, or the volume of the stone is 46.5 per cent of the mass.

In determining sand volumes, the procedure is slightly more complicated. In Fig. 19 is shown a composite photograph obtained by matching together a number of small photographs, taken at low power through the microscope and with a co-ordinate screen in the eye-piece to give the section lines. The actual surface area on the specimen covered by this photograph is 100 sq. mm., or a square 10 mm. on a side; and as this area is very small, it would be necessary to secure a proper average to cover several such areas. For the present, however, an illustrative case only is desired, so that this one area will suffice. It is evident also that in counting areas in such a field, the percentage of error will be proportionately low as the degree of magnification is increased. For this reason, and also in order that the very smallest sand grains may be taken account of, a magnification of about 60 diameters, rather than the lower power here used, is usually desirable. In this manner, by counting the sand areas and deducting from the total area of the field, the ratio of volume of [sand] to volume of [cement + water + air] is obtained.

DATA NEEDED

There are now but three other determinations to be made, in order to have full data. These are: (1) the weight of the specimens, large and small, preferably in grams; (2) the volumes of the specimens, large and small, preferably in cubic centimeters, and (3) the specific gravities of the sand and stone, determined from samples dislodged from the mass. The specific gravity of sand and stone can usually be taken as 2.65, thus omitting the exact determination, unless the character of the materials should be such as to make it seem desirable.

The complete data, then, are as follows:

Ratio of volume of stone to (sand + cement + water + air). Ratio of volume of sand to (cement + water + air).

Weight of large specimen, including stone.

Weight of small specimen of mortar only.

Specific gravity of sand.

FIGURING SAMPLE IN QUESTION

These are all that are needed. The calculations are as follows taking sample of mortar from between large aggregates for micro-examination: Weight of sample, 1680 grams; displacement of sample, 800 cc; by count, 423 squares are sand, out of a total of 896, or 42.75 per cent of volume of specimen.

Then, $0.4275 \times 800 = 342$ cc = sand volume; and weight of sand = $342 \times 2.6 = 889$ grams, where 2.6 is the specific gravity of sand.

Therefore the weight of cement, water and air is $1680 - 889 = 791$ grams; and the volume of cement, water and air, $800 - 342 = 458$ cc. The *weight* of entrained air in sample is negligible.

Therefore:

Let x = volume of water and air in sample,

then $458\ x$ = volume of cement in sample,

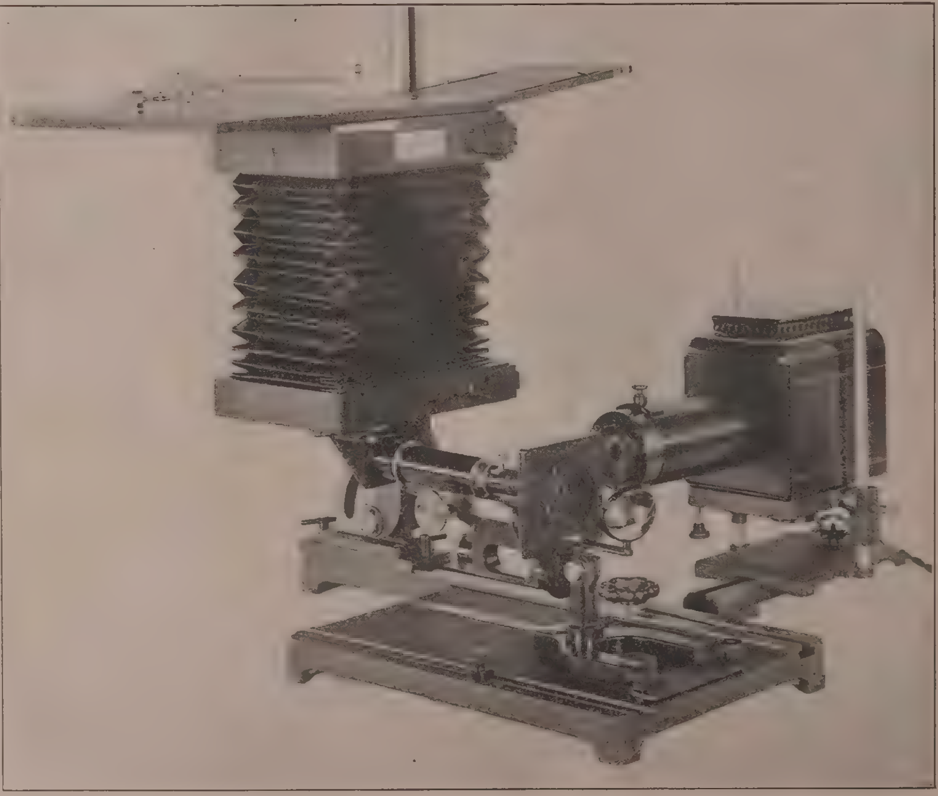


FIG. 20—MICROSCOPE AND MOUNTING FOR INTEGRATING SAND AREAS

and (458 x) 3.1 (sp. gr.) = weight cement in sample,
or, since the specific gravity of water is unity
791 — (458 x)3 = x
or x = 291 cc.
and 458 — 291 = 167 cc = volume of cement in sample.

Moreover, the ratio of sand to cement is expressed by 342:167::2.08:1, and the ratio of air and water voids is 291:800 = 36.4 per cent.

Turning now to the other data, it has been found that the weight of large sample = 4625 grams; volume of large sample = 2100 cc, and, by count, that 67 out of 144 squares are stone. Hence the percentage of stone is 67:144 = 46.5 per cent, or the volume of stone in sample is 0.465 × 2100 = 977 cc; and 2100 — 977 = 1123 cc = total volume (sand and cement + water and air) in large sample.

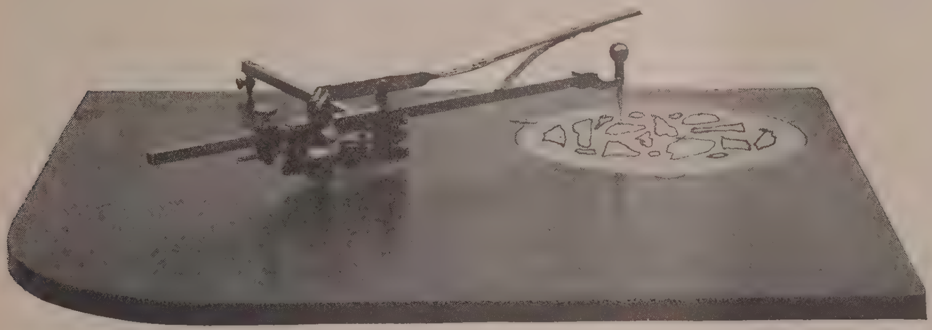


FIG. 21—SPECIAL INTEGRATING TABLE FOR MEASURING SAND AREAS

But it has been seen above that in 800 cc of (sand + cement + water + air) there are 342 cc of sand. Therefore, in 1123 cc there are:

(1123/800) × 342 = 504 cc of sand.
Hence the ratio of volume of stone to volume of sand will be 977:504::2.01:1 = ratio stone to sand.

Therefore, the concrete was mixed in the proportions 1:2.08:(2.01 × 2.00) = 1:2.08:4.02, or, approximately, 1:2:4.

PLANIMETER SIMPLIFIES WORK

In the foregoing demonstration, cross-section ruling was employed to give the relative areas of the various aggregates. This method was advanced for the sake of clearness and simplicity, but it is entirely too cumbersome for practical work. A more rapid and accurate way is to integrate the areas of the large aggregate directly from the sections, by the use of a planimeter, and to determine the areas of the small aggregate by the same means, in conjunction with the apparatus shown in Fig. 20 (manufactured by Bausch & Lomb).

This apparatus, although adapted to many purposes, was designed particularly for cement investigation, with special attachments for the ready performance of concrete analyses. As will be seen, it consists essentially of an ordinary microscope, tipped into the horizontal position; a vertical camera bellows attached to the eye-piece of the microscope through the medium of a prism, and a hooded nitrogen-tungsten incandescent lamp arranged to throw an oblique beam of light on the mortar specimen, held in place on the microscope stage. By the use of oblique light, color values are retained in the projected image, so that aggregates can be differentiated from cement.

The special attachment provided for performing concrete analysis is shown in Fig. 21. This is placed in position at the upper end of the camera, where the plate-holder, or ground-glass screen is usually inserted. As is evident from the photograph, it is nothing more than a circular ground-glass screen set into an extended wooden table, the surfaces of the two being flush with each other. On this table runs a polar planimeter, by means of which the projected images of the sand grains (sketched in ink for illustration) may have their areas rapidly integrated. A little brake on the register wheel of the planimeter, released by the natural position of the index finger when guiding the tracing point, and applied by raising that finger, prevents slip in moving from one image to another. By means of this simple attachment a series of successive surfaces may be integrated without individual readings, this total area being deducted from the known area of the field circle on the ground-glass, multiplied by the number of fields taken.

WEAK SPECIMENS PRESENT DIFFICULTIES

Certain difficulties are presented in this analysis by the specimens themselves. As was pointed out in Article 3, some concretes are of such poor quality that the sand grains, untouched by cement, fall out in the processes of grinding and polishing. When such a concrete is encountered, it is necessary to boil the specimen in a solution of Canada balsam in chloroform, and allow the balsam to harden before grinding and polishing, in order that all the particles may be held in place. Moreover, such concretes usually present the added difficulty of very fine aggregates, but this is readily overcome by increasing the magnification. Such an increase renders the work slower, but has added advantages in reducing the factor of error.

The next article in this series will appear in the issue of March 6.

DANISH PEBBLES FOR GRINDING SAND-CEMENT have been supplanted at the Arrowrock Dam by lava rock chunks of roughly cubical form found along the Government railroad within 15 mi. of the dam. The Reclamation Record states that after a few hours in the mills the angles are worn off and the pieces assume a shape like the ordinary pebble. They are believed to be equal or superior to the Danish pebbles, as they are heavier, break up less and wear longer. A plentiful supply exists on Government land where slides have broken the rock into pieces of the desired size. The Danish pebbles cost $26.25 per ton at Boise, while the lava costs $2 per ton for picking up and 50 cents per ton for sacks, which wear out quickly.

Importance of Grades Increases with Betterment of Road

E. B. McCormick of Office of Public Roads Shows This to Be True—Other Findings Based on Government Dynamometer Tests

THAT light grades are of more importance for good hard roads than for those with a soft surface was one of the points brought out by E. B. McCormick, mechanical engineer of the Office of Public Roads, in a paper presented recently at the annual meeting of the American Society of Agricultural Engineers. In his paper Mr. McCormick outlined the work being done by the Office of Public Roads in the study of the effect of road surface, grade, width of tire and the like on the draft. He described the dynamometer tests run over various roads before and after improving, and presented dynamometer diagrams for different road surfaces. These indicated clearly the greater proportional extra draft for starting a load on hard roads than on soft. A number of diagrams prepared from the various test figures indicate that the increase in draft on grades is about 20 lb. per ton of load per cent of grade, irrespective of the road material or its condition, or of the tire width. This being the case, whereas the level-grade drafts, which he has derived from his tests for the different road surfaces, vary widely, a 15-per cent grade is required to double the level-grade draft on a loose-sand road, while a 2-per cent grade will practically do the same on a road of Belgian block. Notes from Mr. McCormick's paper follow:

INVESTIGATIONS BEING MADE

The work now being done by the Office of Public Roads includes investigations into the effect of road surface, grade, width of tire, diameter of wheel and size of skein on the draft. In connection with this work there are being carried preliminary and final tests on post roads being constructed in various localities of the United States under the supervision of the office. The method of conducting this work is as follows:

Preliminary tests are run over the entire length of the road before improvement is started, and the average draft required and average horsepower exerted over the entire route are calculated. After the completion of the improvements, final tests are run using the same load and width of tire, and wherever possible, the same team and driver. The relative drafts in the two cases afford a means of measuring the effect of the improvement as a whole. In this calculation no account is taken of changes of grade, relocations, etc., the desire being merely to secure the general saving effected by the improvement. An analysis is made, however, of each road, sections are taken out where changes have been made in grade, and where the type of surface has been changed, and calculations are made showing the effect of any particular improvement. In each case, from two to eight different widths of tires are used in the tests.

Other work that is projected, but on which very little has been done as yet, is an investigation into the effective pulling power of horses and mules as affected by (a) weight of team, (b) road surface, (c) grade, (d) continuity of effort, (e) methods of hitching and adjusting harness and (f) rations.

What a Horse Can Do

The dynamometer has been equipped with a timing device to enable calculations to be made for the horsepower developed. It is generally considered that a horse is capable of exerting for an extended period 22,500 ft. lb. of work per minute, instead of one mechanical horsepower of 33,000 ft. lb. per minute. The teams used in these experiments exerted considerably more horsepower than this, even over unusual stretches of road. For instance, two horses on one of the tests at Dubuque, Iowa, developed 3.33 hp over a stretch of 1831 ft.; at Ames, Iowa, four horses developed 5.48 hp over a stretch of 1618 ft., and at Alexandria, Va., four horses exerted 5 hp over a stretch of 1088 ft. At Dubuque, two horses repeatedly developed, over short stretches, more than 6 hp, in one case developing nearly 7.

The dynamometer records over various types of road surface show that the increased draft required for starting a load varies materially with the nature of the road surface, and that the increase in draft is relatively greater on the harder types of roads. For instance, on Belgian block the starting draft may be from four to six times the average of the run; on brick and on block and sheet asphalt, it may be three or four times, while in the case of hard dirt roads, it is seldom more than two or three times. The tests made so far on loose sand indicate that the starting draft will average about twice the running draft.

Drafts for Different Surfaces

The figures that have been given in the past by different authorities for the draft required per ton for hauling wagons over various types of roadways, vary in the case of hard dirt roads all the way from 69 to 224 lb. The draft on sheet asphalt varies from 17 to 50 lb. per ton; on block asphalt, from 28 to 52 lb.; on Belgian block, from 30 to 50 lb. The draft required for loose sand as given by different authorities, varies from 285 to 448 lb. per ton.

The tests from which the records shown in this article were taken, gave the following drafts in pounds per ton on the different roadways: Hard dirt, 106.4; sheet asphalt, 50; block asphalt, 52; Belgian block, 47; loose sand, 315. In the case of dirt roads this value is the average taken from some fifty tests over eight different sections of roadway, the sections averaging about 900 ft. in length. In the case of the pavement the results are the averages from several miles of tests, while with the sand, the value given is the average draft for 1 mi. In the sand $1\frac{5}{8}$-in. tires were used and on the pavement 3-in. tires, but in the case of the hard dirt road the result is the average of eight different tire widths ranging from $1\frac{5}{8}$ to 6 in.

Effect of Tire Width

The question of the effect of the width of tire on the draft is one that is being investigated in all the tests being made with this dynamometer, particularly as regards cumulative effect, that is to say, the relative draft after a repeated number of runs. In order to get data on this subject, as many as seventy-five consecutive runs have been made over the same roadway, particularly in the case of dirt and gravel roads. Because of the large number of variables that enter into an investigation of this kind, it is impossible to draw conclusions from a small number of tests, but it is believed that the work as now being carried on is sufficient in extent to warrant eliminating individual tests that show results distinctly varying from the others of the same group. Much work yet remains to be done with respect to this investigation, but computations made from the data corrected to date are convincing that there is a definite law by which the cumulative effect of the width of tire may be measured, and that this law is the equation of a true parabola, the constants of which vary with the road material. This variation may be sufficient to change the constants for a given width of tire to such an extent that the curve will be convex upward for one class of material, and convex downward for another class.

Effect of Grade

In making corrections for grade it has been customary to consider that the effect of the grade is absolutely independent of the road surface, and also that in grades up to 20 per cent the sine of the angle is practically the same as the tangent. This gives a correction factor of $W/100$ (or 20 lb. per ton) for each per cent of grade. Curves plotted from data taken from these tests sustain this figure.

As the increased draft is a constant, and as the draft for the level grade varies with the road surface, it is evident that the importance of grade elimination depends on the material of which the road is to be constructed. Referring to the figures previously given for drafts of a wagon on various materials, it will be seen that as 315 lb. is necessary to haul a ton on a loose sand road, it will require a grade of more than 15 per cent to double the draft; in the case of a hard dirt, a grade of more than 5 per cent will be required; in the case of sheet asphalt a grade of $2\frac{1}{2}$ per cent will double the draft, while but slightly over 2 per cent is required on a road constructed of Belgian block.

Two Years' Tests Indicate Best Treatment for Chicago Stock Yards Wastes

Engineers of Sanitary District Publish Results of Experiments for Improving the Condition of Bubbly Creek—Fine Screens, Settling Tanks and Filters Used

As THE RESULT of tests conducted by the engineering staff of the Sanitary District of Chicago for a period of 2 yr. the conclusion has been reached that the sewage from the Chicago stock yards, discharging into the notorious Bubbly Creek, can best be treated by fine screening, sedimentation in two-story tanks, and percolation through sprinkling filters. The results of the experimental work were published recently in a report from which these notes were prepared. The degree of purification increases as one, two or all three of the processes are employed. Fine screening alone does not appear to be sufficient and the removal of settling suspended matter from industrial waste is necessary, regardless of the allowable diversion of lake water, the amount of which is the subject of pending litigation between the district and the U. S. Government. In almost every case, screens can be installed at the individual houses, since screening is found to be more effective on the fresh sewage. Screening is, therefore, preferably an individual question for each firm to solve, while sedimentation, requiring more space, can best be handled as a community problem. The solution involves not only a consideration of the municipal and private sewers in and around the yards and Packingtown, but also the efficiencies of various forms of treatment, the size and location of treatment works, and the relation of different steps in the collection and treatment in the future. Flexibility is a prime requisite of any process of treatment. The works should be readily adapted to future extension and should be planned so that they may be made a part of a comprehensive system.

No Treatment of Sewage from Packingtown

At present there is practically no treatment of the industrial sewage from Packingtown other than a partial removal of fat by grease skimming basins. The basins are seldom built to retain settling material, except at the hog houses, and these are insufficient. The screens in use are very coarse and hold back little except intestines. At the stock yards, the Jennings screen is handling the outflow of the Morgan Street sewer. At the other outlets no treatment is given.

From the sanitary standpoint the filling of Bubbly Creek would be desirable, although mere filling alone would simply transfer the nuisance from one locality to another. With suitable treatment of the industrial wastes, it is entirely proper that this dead arm be filled and that part of the 16.5 acres thus reclaimed be used as a site for sedimentation tanks. The fill required can be obtained in part from the construction of the proposed Center Avenue sewer, the proposed sedimentation plant and from the dumping of ashes. The sedimentation plant for industrial wastes only will require 6 acres plus a reservation of 3 acres for future use.

The testing station comprised a coarse screen, rotary screen, grit chamber, settling cans, Dortmund tanks, Emscher tanks, chemical precipitation apparatus, sludge beds, sprinkling filter and incidental apparatus to test various kinds of screens.

Crude Sewage

At different hours of the day the crude sewage varies greatly in strength according to the discharge of wastes from the stock yards and Packingtown. From 8 a.m. to 11 p.m. the suspended matter averages 605 parts per million and for the remainder of the day it is 160. The character of the night flow and Sunday flow was practically identical. Some seasonal variation in strength occurred, the sewage being weakest during the spring and summer and attaining a maximum strength during the late fall and early winter. At Center Avenue on mixed industrial sewage, a biologic oxygen consumption of roughly 1000 parts per million was found for the crude day sewage, whereas at Thirty-ninth Street on domestic sewage this was only 100 to 150 parts per million. The fat content is high in the industrial sewage.

Bars ⅝ in. apart through which all sewage entering the station passed, retained an average of 90 lb. of moist screenings (moisture content 82 per cent) per 1,000,000 gal. The screenings are largely hair, coarse vegetable matter, intestines and similar material quite foreign to domestic sewage.

The grit chamber has been operated at velocities of from 17 to 25 ft. per minute. With a detention period varying between 50 and 70 sec., the suspended matter decreased inappreciably, but there was a slight deposit of detritus,—about 0.02 cu. yd. per million gallon,—largely mineral, with a specific gravity of 1.3 and a moisture content of 44 per cent. The grit chamber has acted largely as a grease skimmer, from 5 to 1260 lb. of scum per million gallons having been removed, containing on an average 75 per cent moisture. Of the dry residue about 60 per cent is ether soluble. This is by no means a complete fat recovery, being less than 11 per cent of the total fat.

DORTMUND AND EMSCHER TANKS

Plain sedimentation was tried in both Dortmund and Emscher tanks, and chemical precipitation in a Dortmund tank. The Emscher tank, at first arranged for a downward and upward flow, was changed in March, 1914, to a straight horizontal flow tank. A daily average of 49 to 69 per cent of the suspended matter in the heavy day sewage can be removed by plain sedimentation in tanks of the Dortmund and Emscher vertical flow types in periods of from 1 to 4 hr. The effectiveness of the vertical flow tanks of the Dortmund or Emscher type depends on low velocities. From 60 to 70 per cent of the suspended matter can be removed in straight flow Emscher tanks in a period of from 2 to 3 hr. Chemical precipitation will remove more than 80 per cent of the suspended matter by using 3.5 grains of iron sulphate and 5 grains of lime per gallon. The improvement from the standpoint of biologic oxygen consumption varied from 18 to 48 per cent for plain sedimentation. Chemical precipitation gave an improvement ranging from 22 to 48 per cent. About one-half the fat was removed by plain sedimentation, while with chemical precipitation treatment about two-thirds was deposited. Acidification removed 69 per cent of the fat. The economy of this process has not yet been demonstrated.

Special experiments on quiescent sedimentation in a deep can, along the lines indicated by Steuernagel at Cologne, Germany, show a removal of 75 per cent of the suspended matter in 2 hr., with 1100 parts per million present. Extended settling over 12 hr. indicates a removal of 79 per cent, which may be taken to represent the settling suspended matter. Detailed results indicate that in a Dortmund tank low velocity is more important than a long period, as the same detention period gives greater efficiencies with the lower velocities.

Scum has persisted consistently on the surface of the Dortmund tanks at all times. Practically none has formed on the chemical precipitation tank, except when alum was used instead of copperas. For the first 7 months of operation, scum formation was excessive on the Emscher tank. With the establishment of thorough ripening, however, the production of scum has shown a marked decrease, particularly during the summer months. Experiments using the effluent from the rotary screen seemed to indicate that scum formation could be largely eliminated in this manner.

Slight odor developed from the Emscher tank. A trace of hydrogen sulphide was occasionally noted, particularly when sludge was being removed. With the other tanks, the odor has been more marked, particularly during removal of sludge.

The amount of sludge retained in the various devices varied considerably per unit volume for individual measurements, apparently due to fluctuations in water content, slight changes influencing the volume very markedly. The relative proportion of bottom sludge and top scum is also a factor of importance.

RELATIVE QUANTITIES OF SLUDGE AND SCUM

Tank	Cu. yd. per 1,000,000 gal.		Period of Observation
	Sludge	Scum	
Dortmund C	3.1	2.7	12 mo.
Dortmund D	6.1	3.5	10 mo.
Emscher E	6.8	1.3	9 mo.
Chem. precip.........	12.7	...	9 mo.

WHERE TESTS OF SEWAGE TREATMENT WERE MADE AT BUBBLY CREEK, CHICAGO

The accompanying table gives approximately the average composition of sludges and scum from the various tanks.

The digestion in the Emscher tank is shown by the decrease in the proportion of volatile matter over the fresh Dortmund sludges. The influence of the precipitant on the chemical precipitation sludge is indicated by the high ratio of fixed matter. The scums are very similar to the sludges from the respective tanks, except that the moisture content is lower. The Emscher scum, however, shows an appreciably higher percentage of volatile matter, indicating that little or no digestion has occurred.

FINE SCREENS

A number of experiments were conducted on the efficiency of fine mesh screens of mesh from 4 to 40 per lineal inch. In most cases the flow was 14,800 gal. per 24 hr. per square foot of screen area, on a screen approximately 3.5 sq. ft. in area, on strong day sewage running to a final loss of head of 4.5 ft. From 134 to 1534 lb. of dry material was removed per million gallon, with a calculated per cent reduction of suspended matter ranging from 10 to 26 per cent. The removal by the 24, 30 and 40 mesh screens averaged from 1098 to 1534 lb. of dry material per million gallon, 60, 80 and 100 mesh screens tested subsequently gave somewhat higher per cent removals of suspended matter, but as the sewage at that time was weaker the pounds of dry material removed per million gallon was less than for the former screens previously tested.

AVERAGE COMPOSITION OF SLUDGE AND SCUM FROM VARIOUS TANKS

Tank	Specific gravity	Per cent moisture	Percentage on dry basis			
			Nitrogen	Volatile matter	Fixed matter	Ether soluble
		Sludge				
Dortmund C..	1.02	90.8	2.65	72	28	8.1
Dortmund D..	1.02	91.7	2.88	76	24	8.6
Emscher	1.02	91.4	2.75	64	36	6.6
Chem. precip..	1.03	89.5	2.21	58	42	5.1
		Scum				
Dortmund C..	1.02	84.1	2.55	71	29	7.7
Dortmund C..	1.02	84.5	2.60	75	25	9.2
Emscher	1.01	84.1	2.73	72	28	12.9

Extended experiments were also made with a small rotary screen of the Weand type 2 ft. 4 in. in diameter and 4 ft. 8 in. long, swung on a steel axle. The coarse screen, rotating 7 r.p.m., supported a 30-mesh screen, and was cleaned by a spray of water directed against the outside, the screenings being ejected at one end by a worm and buckets.

Based on the actual analyses, the average reduction of suspended matter for the first of three runs, each of about 1 month duration, was about 32 per cent, as compared with the average of 17 per cent computed by the addition of the weight of screenings to the effluent. The capacity of the screen was not found to be exceeded with rates of flow between 5300 and 8000 gal. per day per square foot of net effective area, at the lineal peripheral velocity of 51 ft. per minute.

The material caught by the screen differs widely in appearance from the tank sludges and scums, and is usually of a dirty yellow color, full of hay, grain, and other vegetable particles, firm enough as ejected to be forked after slight draining. The material is largely organic, the volatile matter in the dried residue running uniformly over 90 per cent. When delivered from the screen, the moisture content averages between 85 and 88 per cent, but after slight draining is readily reduced to about 80 per cent.

The reduction in biologic oxygen consumption as a result of fine screening was insignificant, averaging about 6 per cent for the month during which these tests were made.

TRAVELING BAND SCREENS

In addition to the work at the testing station proper, additional tests were made on a traveling band screen designed by C. A.

Jennings, located at the outlet of the Morgan Street sewer, and also on a Weand screen, purchased by the packers, and installed at the Sulzberger plant. The Morgan Street sewer receives drainage from a portion of the stock yards only. The sewage is considerably weaker than the ordinary packing wastes. The Sulzberger screen was set up at the outlet for the entire plant. Both these screens were covered with wire cloth with 40 meshes per lineal inch when tested. The duration of each test at Sulzberger's was from 1 to 7 hr. according to circumstances, and it was from 5 to 6 hr. at Morgan Street. The results of these tests are tabulated herewith:

TESTS OF JENNINGS AND WEAND SCREENS

No. of test	Screen	Dry screenings, lb. per 1,000,000 gal.			Per cent reduction suspended matter		
		Max.	Min.	Aver.	Max.	Min.	Aver.
5	Jennings.	1420	945	1150	49	22	33
7	Weand...	2820	320	1690	39	8	26

The initial content of suspended matter delivered to the Jennings screen averaged 340 parts per million, whereas that at the Sulzberger plant averaged 747 parts per million.

In comparison with settling the report states that on the Morgan Street sewage a small straight flow tank of 1.21-hr. capacity removed 3.8 cu. yd. of sludge per million gallon of 88.5 per cent moisture. The removal of suspended matter averaged 63.8 per cent, with an average of 548 parts per million in the influent. This yardage is probably low because the tank unloaded at times. This sludge had an offensive putrid odor, but, based on the removal of suspended matter, the sedimentation plant for the sewage primarily from stock pens is far more effective than screening.

SLUDGE EXPERIMENTS

Sludge from the various devices differed in appearance. That from the Emscher tank was uniformly black and even grained, flowing readily, and had little or no odor, The fresh sludge from plain sedimentation was usually of a dirty greenish black color, frequently having a very offensive odor. The consistency when run from the tank was not uniform, sometimes being very thick, while at other times quite thin. The chemical precipitation sludge was usually of a dirty greenish black, or deep black color, sticky in consistency, and ordinarily had a peculiar sickish or "metallic" odor. The sludge from the secondary settling basin was usually of a deep brown color, very smooth in appearance, with an odor resembling that of decayed vegetables.

Experiments with underdrained sand beds showed that the Emscher tank sludge can be dried uniformly to a spadeable condition in layers 1 to 1.5 ft. thick in 5 or 6 days of good weather. Under these circumstances, the moisture content is ordinarily reduced to about 75 per cent. Although the sludge is still moist it can be removed from the beds without difficulty. With fresh Dortmund sludge dried under similar conditions, the drying time varied from 2 to 4 weeks with a final moisture content of about 75 per cent. The chemical precipitation sludge was even more retentive of moisture, 3 to 4 weeks usually being required.

The Emscher sludge drained largely from beneath. Within 24 hr. after application, the surface became firm and cracks began to appear. With the fresh sludge, the water ordinarily flushed to the surface, making the drying largely a matter of surface evaporation. The chemical precipitation sludge was very retentive of moisture, a thin hard crust forming on the surface while the interior of the mass remained soft and sticky for long intervals. Violent septic action was sometimes noted in this sludge after application to the beds, the surface sometimes falling 6 in. on stirring the mass, by the liberation of entrained gases.

The beds used in these experiments were about 6 in. deep, consisting of graded gravel overlaid with about 1 to 2 in. of torpedo sand. They were exposed to the sun and air.

A few experiments were made with a Kelly filter press, using the chemical precipitation and fresh sludges. Sludge was pumped into the press under pressures of from 70 to 80 lb. per square inch, which were maintained for about 15 min., the filtrate escaping through the press cloth. Irrespective of the initial moisture content, a final result of about 75 per cent was obtained in most cases. The sludge appeared wetter than that of similar moisture content removed from the beds, being more compact. One difficulty with this type of apparatus was found to be the frequent rehandling of sludge necessary, as the cloths became completely clogged after a thin "cake" had formed over them. The interior of the press was left filled with liquid sludge which had to be withdrawn to allow the cloths to be cleaned and then run through again.

SLUDGE FUEL VALUES

Calorific tests showed various sludges to have thermal values varying from 2500 B.t.u. per pound for dried sludges, which had been exposed to the weather for several months, to over 9000 B.t.u. per pound for fresh sludges and screenings on a dry basis. The fresh material, if rapidly dried, has a calorific value comparable to that of poor coal when computed on a dry basis. A considerable portion of these heat units must, however, be used in evaporating the moisture content. A considerable loss of heat-producing constituents occurs, however, on protracted exposure to the air.

SPRINKLING FILTER

Suspended matter in the effluent of the Emscher tank, with which the sprinkling filter was dosed through a cam-controlled Taylor circular spray nozzle, varied from 70 to 210 parts per million, the removal varying from 45 to 76 per cent. The 6-ft. filter layer consisted of 5½ ft. of 1¼ to 2-in. limestone overlying 6 in. of 2 to 4-in. stone. The rates were started at 750,000 gal. per acre daily and were increased from time to time, but a net yield of about 800,000 gal. was considered safe. An average relative stability of 73 was obtained with a maximum of 94 during May, June, and July, based on the methylene blue tests of stability. Average oxygen requirements of the crude sewage were 1000 part per million and 64 for the filter effluent. During May, June, and July, 1914, however, the effluent contained more oxygen in the form of free oxygen, nitrites and nitrates available for the oxidation of the organic matter than was required for complete stability; in other words, the relative stability by this method exceeded 100.

Secondary settling, carried out in a Dortmund tank with a detention period of 1 hr. and an upward velocity of from 2.4 to 3.5 ft. per hour, produced a removal of from 7 to 50 per cent of residual suspended solids. A longer period and lower velocity is required according to the report.

The work was carried out under the direction of Langdon Pearse, division engineer, reporting to George M. Wisner, chief engineer of the Sanitary District of Chicago. Dr. Arthur Lederer made the chemical investigations and L. C. Whittemore, resident engineer, had direct charge of the sanitary engineering features.

Western Society Would Use Engineers in National Defense Plans

REALIZING the engineer's importance in modern warfare the Western Society of Engineers, on Feb. 15, passed resolutions recommending co-operation between the society and the U. S. Army in any plans that may be undertaken for national defense. The following resolutions were passed asking the board of directors to appoint a committee on our military "Factor of Safety":

Whereas the present European conflict has made it self-evident that it is war by the engineer and of his creatures, instruments of destruction;

Whereas there is apparent the necessity of an adequate "factor of safety" in the provision for our national defense;

Whereas our standing army would form in time of great National danger little more than a nucleus around which to assemble our volunteer army;

Whereas any defensive operations against an enemy led by those specially skilled and trained in the art of military engineering will require the services of countless engineers who must be even more proficient;

Whereas West Point cannot furnish a force but little in excess of that necessary to meet the requirements of our standing army in time of peace;

Whereas the National Guard has but comparatively few engineers in its membership;

Whereas it will be largely upon the civilian engineer, handicapped as he is by lack of military training, to construct, operate and maintain the complicated mechanisms indispensable for successful resistance against invasion;

Whereas in an emergency our civil engineers must be familiar with the construction of permanent and temporary fortifications, with rapid road, railroad and bridge reconstruction; the mechanical engineer with the design, manufacture and operation of arms, ordnance, and projectiles, of torpedoes, submarines and aeroplanes; the electrical engineer with various systems of military communication, with the electrically-operated mechanisms of heavy ordnance, turrets, etc., with the placing and exploding of submarine mines; the mining engineer with the construction of earthworks, approaches and terrestrial mines; the chemical engineeer with the practical manufacture of military explosives,

Be it therefore resolved that the Board of Directors of the Western Society of Engineers appoint a committee to ascertain just what this society and its members can do to co-operate with General Kingman, chief of engineers, U. S. A., and other proper military authorities who have already tendered the co-operation of an army officer to work out such details as are considered essential.

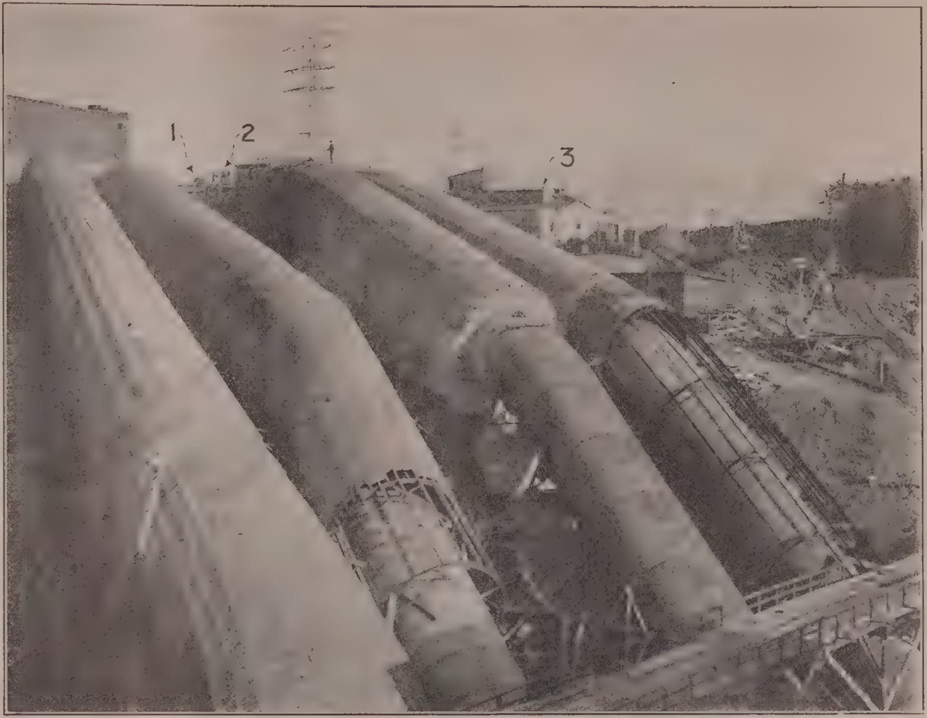
Covering Protects Large Penstocks from Freezing

Cement-Mortar Coating Is Supported by Special Steel Frame Around Pipe and Reinforced with Wire Mesh

By H. G. HUBER
Assistant Superintendent, Shawinigan Water & Power Company

UPON completing the Shawinigan Water & Power Company's power house No. 2, on the St. Maurice river at Shawinigan Falls, Quebec, it was found necessary to apply to the penstocks a covering which would prevent the formation of ice within the pipes. The temperature often falls to — 40 deg. Fahr. during the winter. The protection chosen was a coating applied by the cement gun, supported by a steel frame built around the pipe and reinforced with triangular mesh reinforcement.

There are five penstocks, 14 ft. diameter, and one exciter pipe, with an approximate length of 570 ft. each. The elevation of the center of the pipes at the gatehouse is 171.95 and at the entrance of the power house 54.50.



PENSTOCK COVERING IN COURSE OF CONSTRUCTION
1. Side Dump Car. 2. Cement Gun. 3. Compressor Plant.

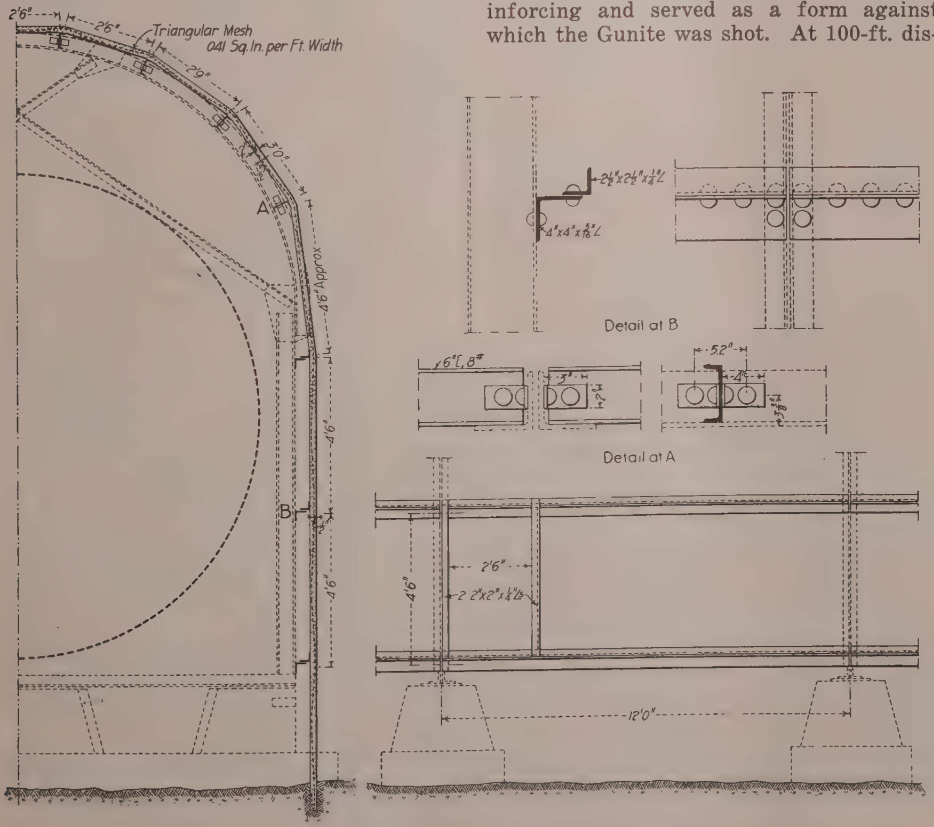
Steelwork

Semi-circular ribs composed of two 3 x 5 x $\frac{3}{8}$-in. angles, were riveted back to back, with a $\frac{3}{8}$-in. filler plate between them, projecting from each end and fitting into a slot in the saddle of the penstock. The saddles were 6-in. channels, riveted back to back. The bays between saddles were spanned by Z-bars and channels. Three Z-bars were riveted on each side to the outside edge of the penstock saddle, and eight channels were placed between the ribs arching over the penstock.

The steel came in lengths from 12 to 18 ft. and had to be cut to exact size on the job. The cutting was done by an oxyacetylene flame. Holes for the lugs at the end of each piece were punched by a No. 3 screw punch. To avoid extra cutting of the Z-bars it was decided to allow them to lap by each other instead of butting the ends.

Paper Covering

After a few bays of steel had been erected, a wire and paper covering was applied. Ordinary poultry netting was stretched over the steel framework and fastened on each side. Over this Mohawk roofing was placed, and then No. 7A triangular-mesh reinforcing. The first wire covering served as a support for the roofing paper, while the paper, in turn, supported the reinforcing and served as a form against which the Gunite was shot. At 100-ft. distances 2-ft. 6-in. x 4-ft. 6-in. manholes were left in each penstock.



STEEL DETAILS OF FRAMEWORK SUPPORTING THE CONCRETE SHELL

A screening plant was erected in close proximity to the sand pile. The plant consisted of a cylindrical screen 17 in. in diameter and 7 ft. long driven by a ½-hp motor. The sand was wheeled to the edge of the chute which led into the circular screen, the first 30 in. of which was solid. The cement was added at this time to allow it to mix thoroughly with the sand while passing through the screen. The screened material passed through a chute into a ¾-yd. side-dump car, in which it was delivered to the cement gun.

The work was divided into two sections, an upper and a lower. On top of the penstock one nozzle man operated on each side from swinging scaffolds which could be raised or lowered. These scaffolds were attached to a light movable frame which slid along the top of the finished work, the crown of the penstock having been shot several days in advance before moving the frame over the surface. This work was accomplished by a man standing on the top of the penstock.

A type FD2-nozzle cement gun was used, made by the Cement-Gun Company, of New York City. Air was furnished from the compressor used for construction operations. No special methods were used.

The work was done under the direction of Julian C. Smith, chief engineer of the Shawinigan Water & Power Company, and of C. S. Saunders, general superintendent of construction. The writer was assistant superintendent, in immediate charge of the work. William H. Gabler was the foreman.

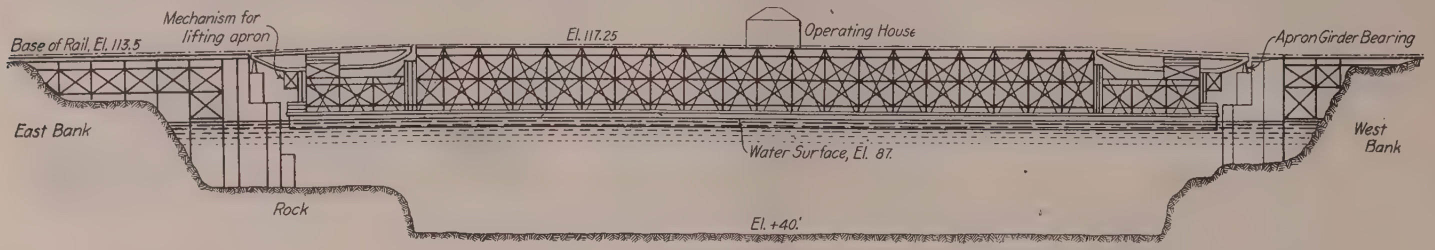
THE MARKET FOR SEWAGE SLUDGE as a fertilizer has been greatly curtailed since the outbreak of the war in Europe. According to the London "Engineer," the war has deprived some English producers of their accustomed profits from the sale of this material in northern France, where large quantities of treated sludge formerly were utilized.

Swinging Pontoon Bridge Carries Railroad Across Panama Canal

Design, Construction and Method of Operation of Floating Structure Across Culebra Cut at Paraiso, Canal Zone

THE pontoon bridge at Paraiso, Canal Zone, over which the Panama Railroad crosses the canal, is similar to bridges used successfully for many years for crossings of the upper Mississippi River. The details of its construction, described recently in "The Canal Record," were worked out to meet the local conditions, using plans of the pontoon bridge on the Chicago, Milwaukee & St. Paul Railway, from Prairie du Chien, Wis., to North McGregor, Iowa.

To afford a clear channel of 300 ft. at the crossing, which is the minimum proposed width of the canal, the abutments for the approaches to the bridge were set in recesses dug back from the original sides of the cut. Another recess was dug in the east bank of the canal, south of the abutment, to contain the barge when the bridge is in the open position.

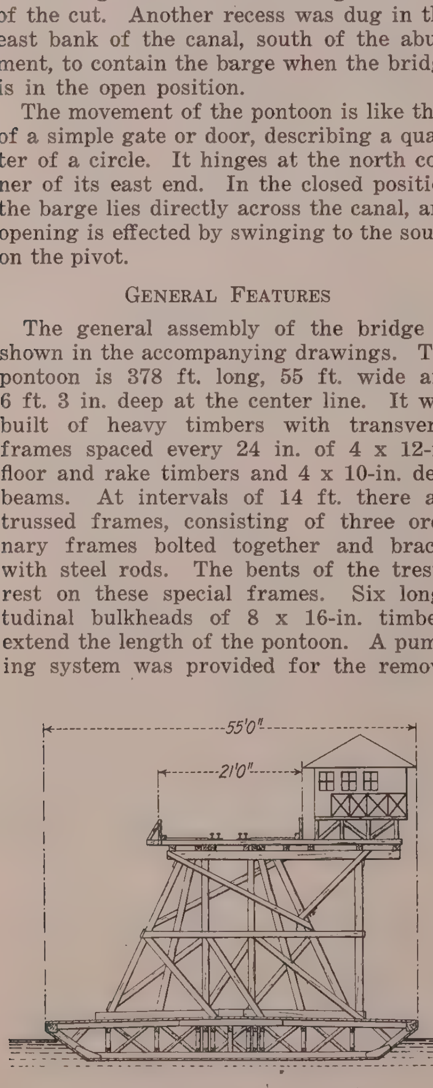


ELEVATION OF BRIDGE—RECESS IN EAST BANK TO CONTAIN PONTOON WITHOUT ENCROACHMENT ON CANAL CHANNEL

The movement of the pontoon is like that of a simple gate or door, describing a quarter of a circle. It hinges at the north corner of its east end. In the closed position the barge lies directly across the canal, and opening is effected by swinging to the south on the pivot.

General Features

The general assembly of the bridge is shown in the accompanying drawings. The pontoon is 378 ft. long, 55 ft. wide and 6 ft. 3 in. deep at the center line. It was built of heavy timbers with transverse frames spaced every 24 in. of 4 x 12-in. floor and rake timbers and 4 x 10-in. deck beams. At intervals of 14 ft. there are trussed frames, consisting of three ordinary frames bolted together and braced with steel rods. The bents of the trestle rest on these special frames. Six longitudinal bulkheads of 8 x 16-in. timbers extend the length of the pontoon. A pumping system was provided for the removal of bilge water. The deck of 3 x 10-in. timbers and the sheathing of 4 x 10-in. timbers were calked and pitched. The deck is to be covered with an asphalt coating.



PONTOON BRIDGE IN SECTION

The trestle bents, spaced 14 ft. apart, consist of a 12 x 14-in. sill 40 ft. long and six 12 x 12-in. posts surmounted by caps 18 ft. long and 12 x 14 in. in section. The outer and intermediate posts are heavily battered, in order to distribute the weight over the width of the barge, and ample transverse bracing is provided. The trestle is designed, in addition to its primary service, to act as a stiffening truss for the pontoon in conjunction with a longitudinal chord of heavy timbers at the bottom of the barge. The track stringers, of which there are three on either side, two 10 x 16 in. and one 8 x 16 in., are fitted with splice plates to form a continuous chord. Additional longitudinal stiffness in the pontoon was provided by horizontal girts and by bracing.

The base of the rails on the approach piers is 113.5 above sea level, and the trestle was built to give a moderate upward gradient from the piers at high lake levels. The base of rail on the trestle is 4 ft. higher than the tiers, or at El. 117.5 ft. when the water in the cut is at the 87-ft. level and there is no live load on the barge. The passage of a train sinks the barge from 6 to 9 in.

The devices for effecting rail connection between the trestle and the piers were made a part of the trestle. They consist, at each end, of an apron hinged near the end of the trestle and extending to rest on the shoulder of the pier. Each apron is made of two spare girders for the lock gates, is 65 ft. long and weighs, equipped complete, with the track, about 150,000 lb. When the bridge is to be opened the aprons are raised clear of the abutments. They are held up until the bridge has been swung to closed position, when they are lowered to rest again on the piers.

Operating Mechanism

The raising and lowering of the hinged aprons is done by a heavy toggle-joint device. The mechanism is attached to the under side of the apron. When the apron is resting on the abutment in its closed-bridge position and is to be raised, the toggle mechanism is drawn to its contracted position. Timber blocking is then built up from the deck to the base of the toggle, and a pull applied to the knuckle of the toggle causes the device to straighten. The resultant thrust pushes down on the blocking and upward on the apron, causing the latter to rise. Consideration is now being given to a plan by which the blocking now built up by hand under the lifting mechanism will be replaced by hydraulic jacks. The knuckle is moved through a worm gear by a 7-hp motor. The motors for the two aprons were originally samples for the operation of the cylindrical valves in the lock wall culverts.

When the apron is lowered to the abutment, the rail connection is secured against lateral or vertical motion. This is effected by a rail-section casting, hinged on the apron end and fitting against the rails in diagonal scarf joints. The whole is made secure in heavy fixed castings. In closed position the joint is locked by transverse bars passing through holes in the base castings and the hinged section. When the bridge is to be opened the bars are withdrawn and the hinged casting is swung up clear of the approach by a counterweight. The movements of the counterweights and locking bars at both ends of the trestle are actuated simultaneously by a single lever in the control house, connecting through signal pipe.

Wildcat and Chain

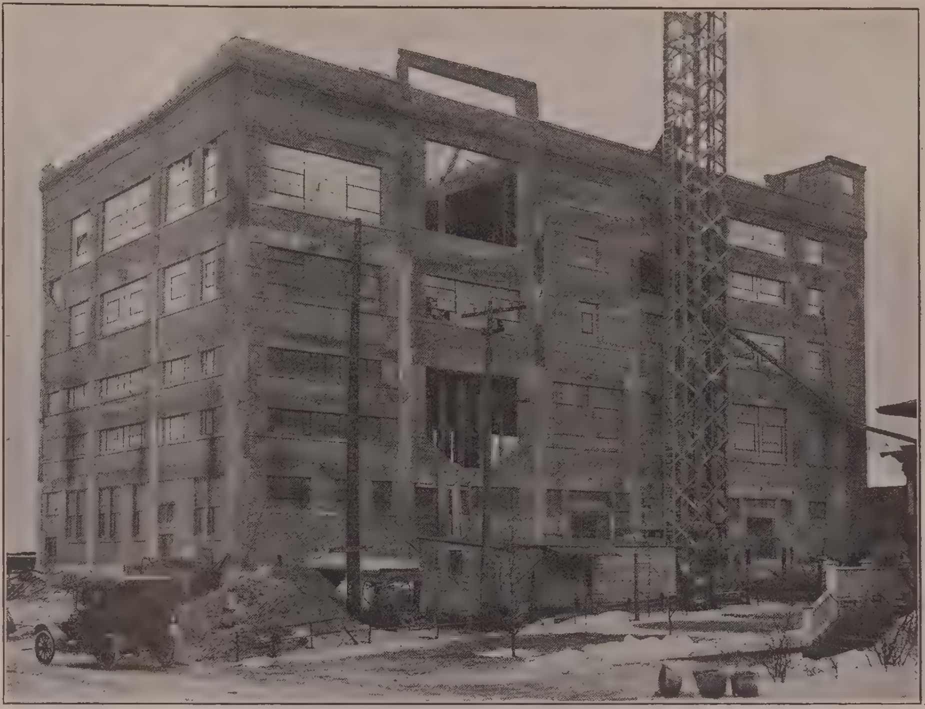
The entire pontoon is swung on its pivot by a wildcat and chain. The wildcat is situated at the outer or west end of the pontoon, and by drawing the chain over its toothed wheel, causes the end of the pontoon to follow the line of the chain. The chain extends from a point about 50 ft. north of the west abutment to one about 350 ft. south of the abutment on the east bank, thus roughly subtending the arc described by the swinging of the outer end of the barge. The chain is carried to the barge through chocks under idlers over the wildcat wheel, and away through similar idlers and chocks. It is 800 ft. long, hence, as motion of the barge can be effected only by tension on the chain on the side toward which the barge is swinging, there is always plenty of loose chain on the lee side; this lies on the bottom of the cut and offers no interference with ships. The chain is fastened to the banks through springs which take up the shock at the time of starting or stopping.

The wildcat wheel is 24 in. in diameter. It is driven by a worm and worm wheel direct connected to a 50-hp motor, which was originally submitted as a sample for use with the Stoney gates of the lock culverts. The worm and wheel are spare parts for the emergency dams. The arrangement is capable of swinging the bridge from open to closed position, or vice versa, in about 8 min. The tension on the chain when the barge is being swung against the maximum wind pressure is about 20,000 lb.

The pontoon is hinged at its southeast corner to the east abutment by a vertical steel pipe, 18 in. in diameter, set in the concrete of the abutment, and inclosed by a steel hinge with a bronze bushing attached rigidly to the barge. The fit is loose enough to allow free vertical motion with the fluctuations of the water surface. The horizontal twisting on the hinge, liable to result from the effects of waves on the barge, is cared for by making the diameter of the inclosing hinge greater at top and bottom than in the center exposing a convex surface toward the vertical pipe.

When the bridge is closed it is locked at its outer end by an adaptation of the ordinary car coupling. The part of the coupler on the barge is as usual, but the part fixed to the west abutment is a vertical casting, 10 ft. long, which can thus be engaged by the other while the water in the cut is at any ordinary level. An air buffer has been provided at the outer end of the barge to take up the shock at the time the barge comes to rest against the coupler.

The operations of the motors for swinging the pontoon and raising the aprons are controlled from the operator's house on the north side of the trestle, near the center. The operator also controls, by manual levers, the signals and derails governing the approaches.



OUTER WALLS OF SCHUST BUILDING WERE NOT DAMAGED BY FALL OF ROOF

Frozen Concrete Responsible for Building Collapse

Monitor and Roof of Schust Baking Building at Saginaw, Mich., Fall, Carrying Away Floors Below

By OTTO E. ECKERT

Assistant City Engineer, Saginaw, Mich.

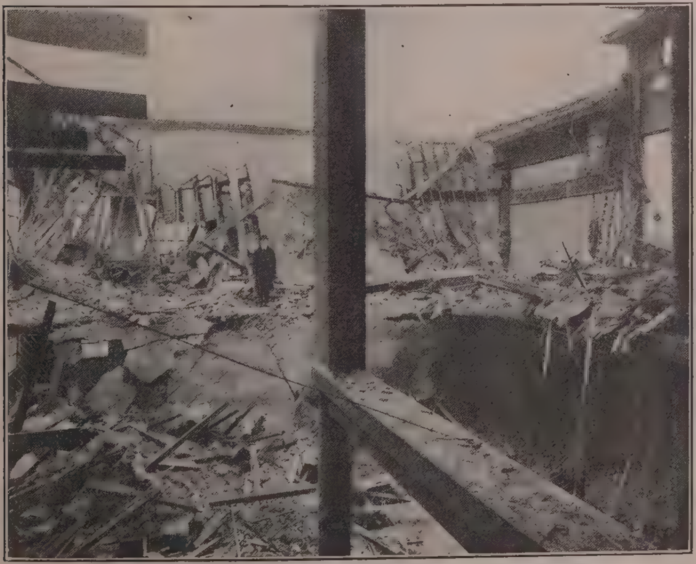
THE monitor and part of the roof of the Schust Baking Building at Saginaw, Mich., fell Feb. 11, carrying with it that part of the floor directly beneath it. The building is five stories high with reinforced-concrete frame, floors and roof, designed to house heavy baking machinery, which has not yet been installed. From a careful examination of the débris it would appear that the 18-in. round reinforced-concrete column, 19 ft. high, which was located where the man is standing in the left hand picture of the three-column cut, failed first by disintegrating at its base, about 6 ft. of it being in such condition that it could not be recognized as part of the column. Concrete at this point as well as at other points would indicate by its nature that it had been frozen and also shows an excess of fine materials at some points, and an excess of coarse materials at other points. The aggregate used was a natural bank gravel, washed but not screened. The proportions of the concrete mixture were 1 part cement to 4 parts gravel.

According to the inspector on the job, the concrete for the columns and spandrals, was poured Nov. 13 and 14, and that for the roof ten days later. It was not thought necessary at the time to heat the material or protect the concrete against the cold.

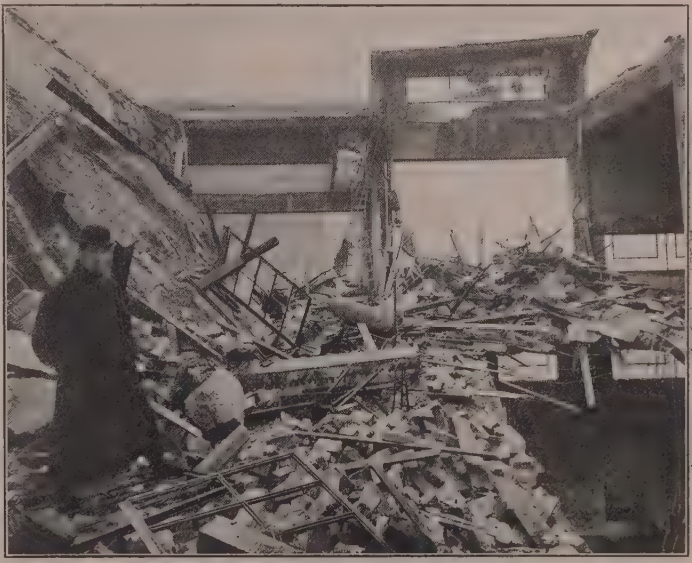
An examination of the local forecaster's weather records shows that 0.41 in. of rain fell on Nov. 3, and that the minimum temperature on Nov. 8 was 27 deg. Fahr; on Nov. 9, 26 deg., and on Nov. 11, 32 deg. From Nov. 12 to 15 the precipitation was 0.99 in., including a small amount of snow. The temperature at this time varied from 32 to 52 deg. On Nov. 16, the temperature went below the freezing point and stayed below all day and continued below freezing until noon, Nov. 18, with a minimum temperature of 15 deg. There was no appreciable thaw until Nov. 24 and 25, so that there is no doubt but that the concrete was injured by the cold spell which came directly after it had been put in place.

The forms were removed about the middle of January and the roof and columns were unsupported until the time of the failure at 6 p. m., Feb. 11. The temperature from Jan. 16 to Feb. 10 was below freezing. At 9:00 p. m., Feb. 10, the temperature rose above the freezing point and continued above until after the time of the failure. The building at this time was also being heated by steam from the interior.

A SAVING OF 45 PER CENT was effected in repairs to asphalt paving by the city of Niagara Falls last year by the installation of a municipal repair plant. The report of F. F. Parkhurst, Jr., city engineer, shows that during the year 39,673 sq. yd. of pavement were repaired at a cost of $29,144.39. If this work had been done at the contractor's price of $1.34 per square yard, which the city previously paid, the total cost of the work would have been $63,161.94.



MAN MARKS POINT WHERE FIRST COLUMN FAILED



COLUMN BURIED UNDER ROOF DÉBRIS AT LEFT

MEETING OF THE TWO SHIELDS—TOP HEADING OF TUNNEL

New Roof Shield Used for Driving Railroad Tunnel in Soft Earth

Two Steel Half-Cylinders Advanced by Hydraulic Jacks Successfully Complete Point Defiance Tunnel, Tacoma

A PAIR of hydraulic roof shields, designed and built for the job, was used to complete the Point Defiance tunnel of the Northern Pacific Railway, near Tacoma, Wash. When this work (described in the Engineering Record of Feb. 7, 1914) was commenced, a high rate of progress was expected with ordinary timbering methods, owing to the apparently firm and well drained condition of the earth to be encountered, and to the known absence of rock. However, when the bore had been driven through the outer crust, which was comparatively dry, a wet, sandy formation was encountered, which called for heavy timbering and made progress by the poling-board method very difficult. The west heading was advanced at an average of only 126 ft. per month for four months, and at the end of this time the contractors faced the necessity of finding some new method of handling the work, or losing heavily on the contract.

A New Shield Developed

The material encountered was very heavy and had a tendency to "flow" around the breast boards into the heading. It was decided that some means must be provided for carrying the weight of this material and protecting the workmen while handling muck and placing timber. Accordingly a steel shield of semi-cylindrical shape was built, designed to be thrust forward by hydraulic jacks, and just large enough to clear timbers and lagging placed beneath it. The weight of this shield and its load was carried on the wall plates at the forward end, and upon the timber segments at the rear.

A segmental I-beam rib, projecting on the inner side of the shield and forming part of it, 4½ ft. behind the cutting edge, served as a shoulder against which the jacks could thrust. Twelve 120-ton hydraulic jacks were used, these being set between this I-beam shoulder and the last segment placed. The width of the shield between wall plates was 31 ft., the rise of arch 14 ft. 10 in., and the overall length 14 ft. In addition to the rib for taking the thrust, the frame had a 4 x 6-in. channel-iron brace in four segments, and a 2½-in. steel tie-rod with turnbuckle. The shell was built of two thicknesses of steel plates ¾ in. thick for the inside and ⅝ in. for the outside. All bolt and rivet heads on the outside of the shield were countersunk. The cutting edge consisted of 1-in. plates, bolted to the shield to facilitate easy renewal. Their forward edges were bent upward slightly to prevent wedging. The shoes on which the weight of the shield was carried at the forward end were steel castings arranged to slide on angles laid on the wall plates.

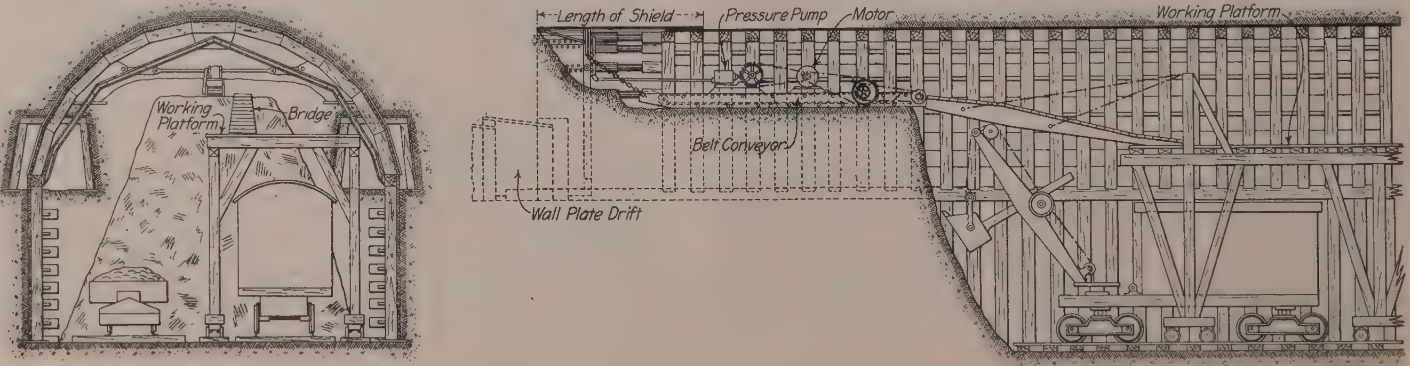
Equipment

A bench, 24 to 28 ft. long, and of convenient height, was left in the middle of the heading, on which to handle muck and timbers, and as a safeguard against overbreak. The jacks were fed from a hydraulic pump, and driven by an electric motor, set on this bench. This motor also operated a conveyor belt which delivered muck from the heading across the bench to a Marion 40-ton steam shovel running on the tunnel floor. The shovel, which ran with compressed air, loaded this material into 4-cu. yd. cars and also excavated the bench. These cars, of 3-ft. gage, were handled, in trains of two to six at a time, by a 6½-ton electric locomotive. Motor-driven belt conveyors were also used to remove muck from the two wall-plate drifts. These conveyors were arranged so that they could be reversed and used to carry timber into the drifts.

The timber was sawed into standard lengths outside the tunnel and sent in as needed. In order to maintain easy access and thus facilitate the handling of timber, a "high-car" was constructed, whose platform cleared the top of the shovel. A bridge was used to connect this platform with the bench, and the car was thus kept back of the sweep of the shovel boom. The car ran on rails placed on either side of the track provided for the shovel.

Operation

The normal working pressure on the hydraulic jacks was about 10 to 13 tons, although the initial pressure at starting sometimes rose to 30 tons. The maximum pressure was 50 tons, or a total of 600 tons on the entire shield. After each advance of 4 ft., timbers for a new segment were set. The rate of advance through sandy formation was usually 1 in. per minute, which was found to be about as fast as miners and muckers could handle the material. In order to measure and control the movement of the shield, three measuring rods graduated in inches were attached to it, parallel to the tunnel, one at the top and one at each of the wall-plate shoes. The man who controlled the operation of the jacks stood where he could watch the advance of the top rod, and assistants at each of the other rods called to him the advance of the shield on each side. By closing or opening one or more jacks on either side, the direction of the shield was easily controlled. Curves were successfully driven



TOP HEADING OF TUNNEL WORKED UNDER ROOF SHIELD—SPOIL HANDLED WITH BELT CONVEYORS AND STEAM SHOVEL

LABOR AND LUMBER COSTS, POLING BOARD METHOD, JULY, 1912.

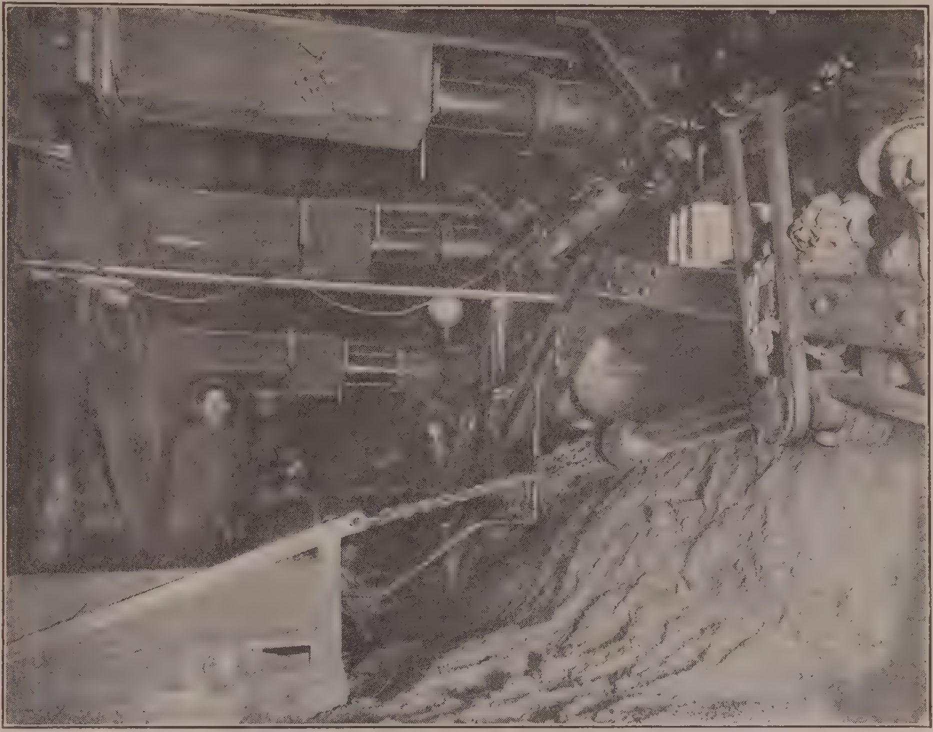
Shift boss......	30 days	@ $5.00 per day	$150.00
10 miners	30 days	@ 3.00 per day	900.00
17 muckers	30 days	@ 2.50 per day	1,275.00
False timber in place	73,392 bd. ft.	@ 10.00 per M	733.92
Electrician	30 days	@ 4.00 per day	120.00
Total for day shift..................			$3,178.92
Shift boss......	30 days	@ $5.00 per day	$150.00
10 miners	30 days	@ 3.00 per day	900.00
17 muckers	30 days	@ 2.50 per day	1,275.00
False timber in place	73,392 bd. ft.	@ 10.00 per M	733.92
Total for night shift................			$3,058.92
Total			$6,237.84
Credit (89,786 board feet of permanent timber furnished by Northern Pacific Railroad and put in place by contractor at $11 per M)........................			987.64
Net total for the month.............			$5,250.20
Distance tunneled for month, 136 linear feet.			
Cost per linear foot......................			$37.77

LABOR AND LUMBER COSTS USING SHIELD, MAY, 1913

Shield foremen.	29 days	@ $5.00 per day	$145.00
Shift boss......	29 days	@ 5.00 per day	145.00
10 miners......	29 days	@ 3.00 per day	870.00
13 muckers....	29 days	@ 2.50 per day	942.50
False timber in place	19,700 bd. ft.	@ 10.00 per day	197.00
Electrician	29 days	@ 4.00 per day	116.00
Total for day shift..................			$2,415.50
Shield foremen.	29 days	@ $5.00 per day	$145.00
Shift boss......	29 days	@ 5.00 per day	145.00
10 miners......	29 days	@ 3.00 per day	870.00
13 muckers....	29 days	% 2.50 per day	942.50
False timber in place	19,700 bd. ft.	@ 10.00 per day	197.00
Total for night shift................			$2,299.50
Total			$4,715.00
Credit (226,156 board feet of permanent timber furnished by Northern Pacific Railroad and put in place by contractor at $11 per M)........................			2,487.71
Net total for the month.............			$2,227.29
Distance tunneled for month, 394 lin. ft.			
Cost per linear foot......................			$5.65

by maintaining different rates of progress on the two sides.

In soft ground the workmen excavating at the cutting edge stood on the turnbuckle thrust-rod which afforded a good footing while they leaned against the face of the heading. Four shovel men cut away the material a few inches ahead of the cutting edge, or took it out through holes in the I-beam ring when it packed up ahead of this projection. About eight muckers were usually required to shovel into the conveyor and keep the bench clear.

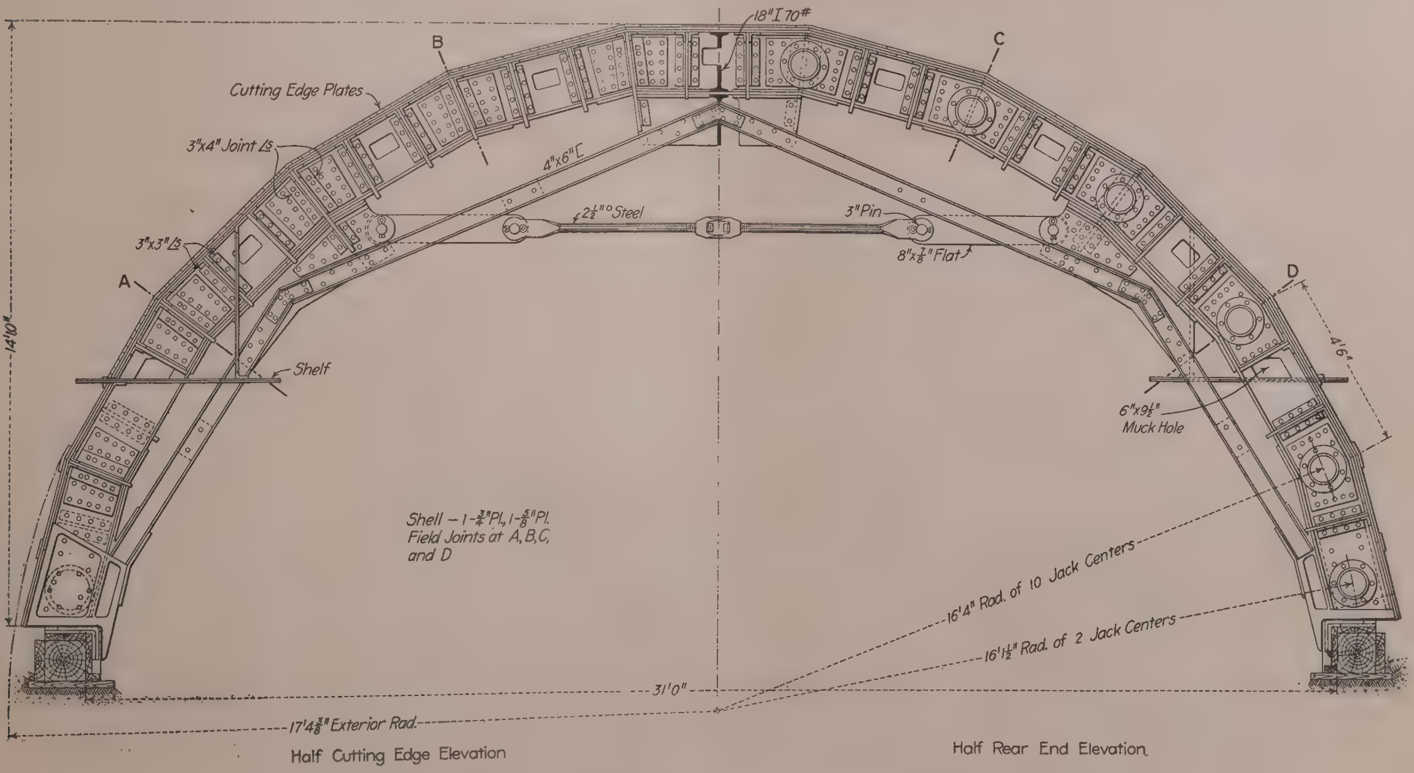


JACKS EXTENDED TO FULL REACH IN SHOVING TUNNEL SHIELD

The wall-plate drifts were so worked that their headings were always 18 or 20 ft. in advance of the cutting edge. As the shield advanced the earth at the sides of the bench was cut away below the wall plates to the tunnel floor, and plumb posts put in place in the usual way. The wall-plates were placed by the engineer in charge of the work and securely blocked.

COST AND PROGRESS

With the poling board method the progress with a shift of thirty men had been only 4 to 6 ft. a day, but with the shield in full operation the same number of men advanced the heading 12 to 16 ft. a day, and eliminated all the false timber work required by the former method. The first shield built was tried out near the west portal. Progress with it was very satisfactory, and it was decided to build a second shield. The shields were fabricated by the Seattle Drydock & Construction Company at a cost of about $3500 each. They were made in five sections, and after being assembled in the shop were taken apart for shipment and re-erected in the tunnel. The shield was designed and patented by W. M. McDowell, of Tacoma, and the work done with it in the Point Defiance tunnel was carried out under his personal supervision.



SPECIALLY DESIGNED ROOF SHIELD FOR DRIVING POINT DEFIANCE RAILWAY TUNNEL IN SOFT SOIL

Cooperation the Keynote of Lincoln Highway Movement

Through Joint Efforts of States, Cities and Private Organizations 2500 Miles of Coast-to-Coast Route Have Been Marked and Improved

BACKED by States, counties, cities and villages, as well as the nation's greatest men from the President down, the Lincoln Highway, a coast-to-coast memorial road projected 2 yr. ago, is today a reality.

Since the Lincoln Highway Association issued its proclamation in September 1913, naming the exact route it proposed to follow, 2500 mi., or more than 75 per cent of the entire distance, have been designated with the official red, white and blue markers. This means five to eight markers to the mile. Hundreds of miles of city streets and country roads have been renamed by the proper authorities, "Lincoln Way." Many towns and cities along the route have erected arches or welcoming signs at the entrances of the highway into their confines, while other cities are broadening and beautifying that portion of the route in their immediate vicinity. The local governing highway bodies from the smallest villages to the State highway departments are improving the highways under their jurisdiction, which have been chosen as integral parts of the Lincoln Highway.

The cement industry of the United States, representing approximately thirty-eight constituent companies, has voluntarily contributed 1,500,000 bbl. of cement. A large number of automobile manufacturers, manufacturers of tires and sundries, have already contributed on the basis of 1 per cent of their gross sales for the period of 1 yr., with the understanding that the payments made may extend over a period of 3 yr. Hundreds of individuals and concerns throughout the country have pledged definite sums ranging from $100 to $10,000.

PRELIMINARY INVESTIGATION

In selecting the route, the natural line of cross-country travel as well as the topography, climate, accessibility and directness were taken into account. In general the route of the Lincoln Highway has been in existence for nearly a century and is today the main Overland Trail, and that part lying West of Chicago, is known by that name.

Road engineers and officers of the association traveled over the tentative routes and viewed every foot of the way before action was taken. A month before the route was announced to the public the plans were put before a conference of the Governors of the States traversed and their approval secured.

Aside from the many sources of aid mentioned the Lincoln Highway Association is endeavoring to raise a fund of $10,000,000, which, by co-operation with the local communities, it has been estimated will be sufficient to furnish the hard surfacing material necessary to improve 2000 mi. of road. It is part of the plan to link into a continuous route the many miles of road between New York and San Francisco which are entirely suited to the needs of trans-continental travel.

In Ohio, of 229 mi. of Lincoln Highway, 145 mi. are hard surfaced with concrete, brick or other material. A substantial additional mileage will be added this year. In Indiana $275,000 was recently voted solely for Lincoln Highway. Iowa spent $200,000 on the highway during 1914 in raising grades and widening roadways to a uniform width of 30 ft. The co-operative spirit that predominates the State and county engineers along the route is typified in the action of the Governor and State engineer of Wyoming in naming it a State highway and shortening a former 52-mi. route between Cheyenne and Laramie by 6 mi.

At Mooseheart, Ill., the Loyal Order of Moose of the World has constructed a section of concrete road ¾-mi. long and 18 ft. wide, costing $12,000. A man in Los Angeles has contributed as a memorial to his mother, who was an Illinois woman, seventeen drinking fountains to be placed in the business sections of the towns on the Lincoln Highway in Illinois. The General Federation of Women's Clubs, representing over a million women, have decided to undertake the beautification of the highway, and to that end have appointed a tree planting committee with chapters in all the States through which the road passes.

The American Institute of Architects, through its president, R. C. Sturgis, will co-operate in the preparation of designs for arches, tablets, memorials, and bridges to be erected along the highway. (See editorial on page 549 of the Engineering Record for Nov. 21, 1914).

WORKING ORGANIZATION

The working organization of the Lincoln Highway Association, which is incorporated under the laws of Michigan, is as follows: First, a board of directors consisting of twelve men representing various business interests throughout the country; second, an executive committee consisting of five directors, whose place of residence is convenient to the national headquarters; third, a president, two executive and three honorary vice-presidents, together with a secretary and treasurer. Comprised in the organization is a list of founders, made up in a large part, of the original contributors to the fund which will make the highway possible. In each of the States traversed, and in the contiguous States, there is a chief State consul, who is a representative of the executive committee and the directors in the commonwealth in which he lives. These chief consuls are empowered with the authority to appoint associate or vice consuls in the counties, cities, and villages along the route. The organization also consists of a definite number of consuls-at-large whose duties are to represent the executive committee in company with the State consuls throughout the territory along the route of the highway and the natural tributary routes.

DUTIES OF CONSULS

The duties of the chief consul of each State, together with the consuls-at-large, are to stimulate interest and arouse patriotic enthusiasm for the Lincoln Highway. In more detail the methods involve interviews, publicity, addresses to civic and good roads organizations and commercial clubs, and general educational work regarding the project.

Upon completion of the $10,000,000 fund, nearly one-half of which has been raised, the directors believe that three years' actual construction will be required to put the 3389 mi. of highway in such a condition that it will be possible to tour from New York to San Francisco in comfort in fifteen days of leisurely traveling. A. R. Pardington, of Detroit, is vice-president and secretary.

Closure Made at Elephant Butte Dam, New Mexico

DURING January notable progress was made on the dam of the Elephant Butte storage project in New Mexico. A total of 38,400 cu. yd. of masonry was placed during the month and on Jan. 7 the flume which has carried the entire flow of the Rio Grande for 2 yr. was closed and for the first time water passed through the outlets provided in the dam. The following figures were taken from a report by E. H. Baldwin, construction engineer on the project:

The best day's run was on Jan. 25, when a total of 2651 cu. yd. of masonry was placed; this was made up of 2129 cu. yd. of concrete and 522 cu. yd. of plum rock. The placing of this amount of concrete required the mixing of 2500 bbl. or 12½ carloads of cement, 1100 cu. yd. of stone, and 675 cu. yd. of sand and gravel. The 8-hr. day shift placed 1300 cu. yd. of concrete and 370 cu. yd. of plum rock, a total of 1670 cu. yd. of masonry. The night shift was not able to do as well because of being handicapped by a shortage of crusher rock.

The abutments have been brought up to El. 4315 or higher, so that the dam is thought to be absolutely safe from any danger due to floods, for even should an unprecedented flood overtop the dam, it would pass harmlessly over the lower blocks of masonry. The total of masonry placed to date is 456,860 cu. yd.

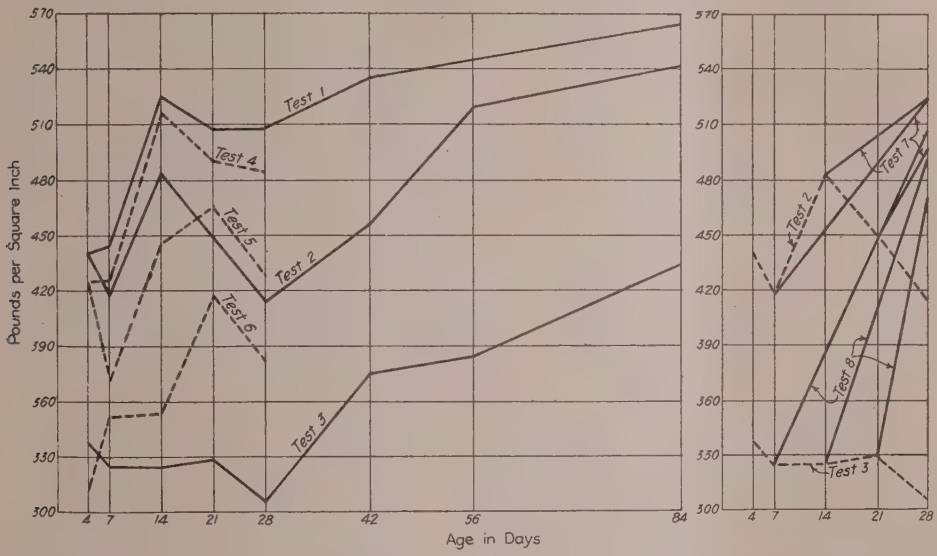
The total excavation during January was 2200 cu. yd., making a total to date of 388,500 cu. yd. The cement plant broke all previous monthly records by turning out, on three-shift operation, 39,000 bbl. of sand cement. With the exception of some piping necessary for operation, the erection of the gates and valves is completed. The seven gates and valves on the lower level have all been operated and are said to work very satisfactorily. The last time they were closed the entire operation for the seven gates occupied only 15 minutes. At the end of January the Elephant Butte Storage project, including all auxiliary features, was reported to be 83 per cent completed.

MORE NON-TECHNICAL Instruction should be given in engineering courses, in the opinion of Dr. Alexander C. Humphreys, president of Stevens' Institute of Technology, as expressed in a lecture delivered recently at Brown University. He does not believe a broader preparation is to be secured by lengthening the college course to six years—in fact, he feels that "an extended stay in college or university tends to disqualify for the practical duties which the engineer has to perform." He thinks, however, that the course of study should be kept in balance, that more emphasis should be laid on the non-technical studies, such as English, and on the cultural side of all studies included in the curricula, and that there should be instruction in the principles of accountancy, "ignorance of which has given so many engineers an unfortunate reputation with bankers and investors on the score of faulty estimates on cost of construction and cost of operating."

Concrete Briquettes Subjected to Cold Weather Tests

Series of Experiments Conducted to Parallel Conditions Existing During Building Construction in Winter

In order to determine the influence of normal and low temperatures on the strength of concrete the Aberthaw Construction Company, of Boston, engaged Herbert L. Sherman to conduct a series of tests intended to parallel as closely as possible the conditions existing during the construction of buildings in cold weather. It was desired to learn what heating was necessary to make concrete strong enough to permit the removal of forms, and to find out how strong concrete was under different treatments. It was particularly desirable to learn whether concrete, which had been heated for several days and then allowed to cool to the temperature of the winter air, increased in strength, and, if so, how fast and how much. This reproduces the common practice of heating a concrete building for some days, and then leaving it unheated.



BREAKING STRENGTHS OF BRIQUETTES SUBJECTED TO COLD WEATHER TESTS

If tests should indicate that concrete does not increase in strength after the heat is removed, or if it increases only very gradually, there would be little reason for leaving the forms in place beyond the period of heating. If the concrete does not increase in strength after five days' heating, then the strength of the concrete would be that of six-day-old heated concrete, even if the forms are left in place during cold weather for three or four weeks. Leaving the forms in place would mean a waste of money, if conditions are entirely safe at the end of six days.

No claim is made by the Aberthaw Company that this series of tests is complete, or that it proves anything definitely. It simply shows the strength of this particular set of briquettes, made in the way described.

LARGE SCALE TESTS DESIRABLE

It is to be noted that the interior of a mass of concrete is protected by the exterior, and that the effect of cold upon a small briquette is more sudden and more thorough than it would be on a large mass of concrete. It must be recognized that concrete throws off heat in setting, and that this setting heat helps force the set of the concrete. It is desirable to study the matter further with full-size sections of concrete. It is probably fair to reason that a full-size section of concrete is less seriously affected than the small briquette.

It is to be remembered that, in heating a concrete structure, the ceiling and upper sections of the columns are kept very much hotter than the lower sections of the columns, particularly the lower part of the wall columns. And it is very common to design the wall columns with reference to architectural treatment, very often making them much larger than would be necessary to carry their loads. This feature has probably saved many failures.

In all the tests, there was used a mixture of several brands of Lehigh Valley cement, and standard Ottawa sand. All briquettes were mixed at the same time by the same man, in a room at approximately 72 deg. Fahr. temperature. All briquettes, which were held between 40 and 70 deg. were kept moist. Briquettes were tested in a standard machine. Frozen briquettes were allowed to thaw out before testing.

LOG OF TESTS

Test 1.—For the purpose of comparison, these briquettes were made of 1 part cement, 2 parts sand, gaged with water. Materials were at a temperature of approximately 72 deg. Fahr. when mixed, and briquettes after molding were kept at a nearly constant temperature of 72 deg. The average results are shown in the accompanying table.

Test 2.—Mortar and materials mixed the same and under the same conditions as for test 1. Briquettes were kept at 72 deg. for four days, then placed in cold storage at an even temperature of 29 deg. until the time of breaking.

Test 3.—Mortar and materials mixed the same and under the same conditions as for test 1. Briquettes were molded at 72 deg., kept at 40 deg. for four days, then placed in cold storage at a temperature of 14 deg. up to the time of breaking.

Tests 4, 5 and 6 parallel exactly in their order tests 1, 2 and 3, except that 5 per cent salt solution was used in the mortar instead of clear water.

Test 4.—Same as test 1 except 5 per cent. salt solution used. Specimens were held at 72 deg.

Test 5.—Same as test 2, except 5 per cent salt solution used. Briquettes molded and held at 72 deg. for four days, then placed in cold storage at a temperature of 29 deg. until breaking.

Test 6.—Same as test 3, except 5 per cent salt solution used. Briquettes were molded at 72 deg., kept at 40 deg. for four days, then placed in cold storage at 14 deg. up to the time of breaking.

Test 7.—Nine briquettes were made the same as for test 2, except that three of these were removed from the 29 deg. temperature at the age of seven days, three at the age of fourteen days and three at the age of twenty-one days. All briquettes removed were kept at 72 deg. until they reached the age of twenty-eight days, when they were all broken at the same time.

Test 8.—Nine briquettes were made under the same conditions as test 3, except that three of these were removed from the 14 deg. temperature at the age of seven days, three at the age of fourteen days, and three at the age of twenty-one days. These were all held at 72 deg. after removal, and were all broken at the end of twenty-eight days.

For convenient comparison, the table gives the average strengths of each of the eight tests, placed side by side.

COMPARISON OF AVERAGE RESULTS OF EIGHT TESTS

Days	Lb. per sq. in. under Test No. 1	2	3	4	5	6	7	8
4	441	441	338	425	425	313	...	...
7	445	419	325	425	371	353	...	...
14	524	484	325	516	446	355	...	...
21	507	450	329	490	466	417	...	...
28	507	414	306	484	427	381	...	...
42	535	456	375	...	...	...	...	...
56	...	519	385	...	...	...	...	...
84	564	541	433	...	...	...	...	...
7-28	...	...	...	...	...	...	525	510
14-28	...	...	...	...	...	...	525	495
21-28	...	...	...	...	...	...	500	470

From tests 4, 5 and 6 it was hoped to find if the presence of salt was any aid to the hardening of concrete at temperatures below the freezing point. From tests 7 and 8 it was hoped to find whether concrete which was first subjected for a limited period to warm weather, then frozen, then thawed out and kept warm, would recover promptly and become as hard as concrete in summer conditions.

INTEREST CHARGES have hurried sky scraper construction so much that recent buildings in Chicago have been completed within a year, whereas a few years ago, and in other cities now, from 1½ to 2 years are considered the necessary interval. The Kaiserhof was finished in eight months and the New Morrison Hotel in twelve months, said Charles E. Fox at the convention of the American Concrete Institute. Steel specifications call for the erection of two stories per week, and on the New Morrison the contractors sometimes erected two stories per day. Three months' time is saved by working from the ground level up and down, rather than waiting until the deep excavations are entirely completed before starting the superstructure. In the hotel noted above the excavation went down 52 ft. below sidewalk grades and was completed during the same week that the roof was finished. Owing to the great depth of the basements it is found necessary to utilize steel-column framework, rising from the tops of the caissons, in the cross-bracing system to support the retaining walls. The weight of the superstructure is a material factor in maintaining this stiffness of the substructure bracing.

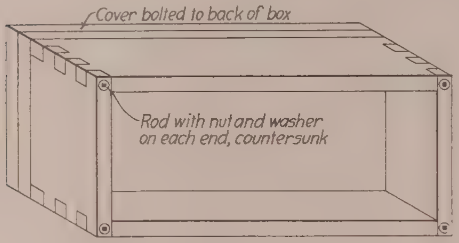
Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

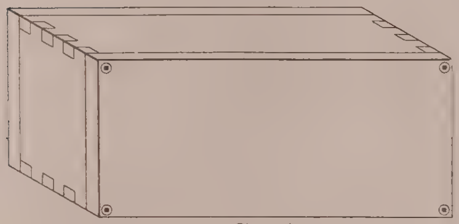
Sectional Bookcase and Shipping Box for Technical Works

SIR: Accompanying is a sketch of a sectional bookcase and shipping box which is very convenient for engineers who find it necessary to make frequent changes of base, from town to town, or from camp to camp.

The boxes should be made of some light, strong wood, such as white pine, and of a uniform size, to take the standard-size engineering books, that is 11 in. high and 7½ in. deep, inside. Uniformity of size is the essential feature, as this makes it possible to stack the boxes up against the wall like sectional bookcases.


Cover bolted to back of box
Rod with nut and washer on each end, countersunk

Open



Closed

When camp is reached the nuts and washers on the cover are removed with a pair of pliers, the rods are drawn out and reversed and the cover is bolted on the back. The nuts, being countersunk, are always out of the way, and the cover does not get mislaid.

Such boxes can be cheaply made in any construction camp or carpenter shop, and if made of 1-in. or 1¼-in. material, will stand very rough handling.

FRANK C. BOES.

Brooklyn.

World's Record in Concrete Placing

SIR: In the Engineering Record of Feb. 13, 1915, page 199, George T. Seabury, principal assistant engineer, New York Board of Water Supply, presents an article dealing with the yardage of concrete placed in the Kensico dam, and in this connection makes a claim of a record better than the best records made on the Panama Canal locks. In making the claim Mr. Seabury refers to a former letter by the writer, published in the Engineering Record of April 4, 1914, page 404, in which a previous claim for a world's record in placing concrete on the Kensico dam was challenged. The figures used by the writer in the letter above referred to were not by any means the figures for the best month's record on the Panama work.

Mr. Seabury's present claim is based on a volume of masonry placed between July 25 and Aug. 24, 1914, aggregating 84,450 cu. yd., of which 9440 cu. yd. were concrete blocks and cyclopean masonry. The following is a list of monthly records made in the Panama work, any one of which excels the Kensico record referred to:

	Cu. yd.
June, 1910, Gatun Locks	89,401
August, 1910, Gatun Locks	85,686
October, 1910, Gatun Locks	86,946
March, 1911, Gatun Locks	86,884
April, 1912, Miraflores Locks	97,735
May, 1912, Miraflores Locks	92,095

The average for the six months mentioned is 89,791 cu. yd. Considerably better records will have to be made on the Kensico dam before the best Panama records will be equaled.

In connection with the Panama Canal work, it may be of interest to know that the following yearly records for concrete construction were established:

	1910	1911	1912
Gatun Locks	886,451	758,821	142,011
Pedro Miguel Locks	444,947	301,893	102,721
Miraflores Locks	97,501	474,832	736,443
Total	1,428,899	1,535,546	981,175

Total for three years, 3,945,620 cu. yd.

The writer has no desire whatever to attempt to minimize the records made on the Kensico dam, but at the same time feels that it is not fair to establish claims to a record for the Kensico work to which it is not entitled.

J. EDWARD CASSIDY,
Philadelphia. Consulting Engineer.

Lumber Mattresses for Bank Protection

SIR: In comment on a well-written article appearing in the Engineering Record, Dec. 26, 1914, page 686, entitled, "Lumber Mattresses for Bank Protection in Louisiana," attention is invited to the statement made therein that these mattresses are "similar to those used by the Mississippi River Commission." This is probably an error, as it is not known that lumber mattresses of this type have ever been used by the commission.

The lumber mattress as illustrated in the article referred to was originated in 1897 by W. S. Mitchell, assistant engineer in the U. S. Engineer Office, St. Louis, adjoining but not directly under the Mississippi River Commission, and has since been much employed on the Mississippi River in that district (from the Ohio to the Missouri River) whenever justified by shortage of brush and relative costs of both materials. A comprehensive article on this subject may be found in the Annual Report of the chief of engineers, U. S. A., 1901, pages 2212-2220 inclusive.

Modifications in details of construction may of course be made to conform to local requirements. In the St. Louis Engineer District a headblock heavier than is stated in the article is required, being made of three double thicknesses of 1 x 6-in. planks. The standard size of wire in the St. Louis district is No. 14, galvanized. The No. 10 wire mentioned in the article, while resisting rust for a longer period, is stiffer and can not be twisted so tightly by hand, consequently the use of smaller wire permits more rigid and satisfactory work.

The value of the joint shown between the lumber and the concrete at the inner or shore edge of the mattress is thought to be somewhat overestimated, as its efficacy is confined to the strips of lumber inclosed by the concrete. No protection except by the riprap is given to the mattress immediately below the joint, which may also be exposed to destruction and decay during low stages of the river. If intended to prevent movement of the mattress it would seem to be unnecessary, as a mattress of this type when sunk into place does not again move bodily, any subsequent change taking place locally, and only as the result of disintegration or destruction, which more frequently begins at the outer or river edge. The joint would probably have been quite as efficient had it been made flush with the top of the mattress, the upper half of the concrete being omitted.

In the St. Louis Engineer District the subaqueous mattress is usually placed prior to grading the bank, in order to stop the caving, which frequently proceeds so rapidly that any previous grading would be rendered useless.

Riprap is more permanent, and less liable to be swept off by waves, drift and, in northern latitudes, ice, if made of suitable stone placed by hand in the form of paving, instead of being piled at random as shown in the illustration.

J. W. SKELLY,
Assistant Engineer, U. S. Engineer Office.
St. Louis.

Eccentric Riveted Connections

SIR: The letter of John C. Prior, in your issue of Feb. 13, 1915, page 212, criticising eccentric rivet diagrams, was noted with interest. From a theoretical standpoint Mr. Prior is perfectly correct in his criticisms. The diagrams are only remotely based on a rational formula, the assumptions being such as to make them practically empirical. The results obtained from the diagrams are, however, as previously stated, correct to the nearest rivet for ordinary cases, not for extreme cases.

The most serious error that might result from the blind use of these diagrams has not been pointed out by Mr. Prior. When the value of L approaches zero, the number of rivets given by the diagrams also approaches zero, a result evidently incorrect. For this reason the diagrams are of little use for very small values of L. In such cases, however, the total required number of rivets approximately equals W divided by the strength of one rivet.

CHARLES D. CONKLIN, JR.
Cheltenham, Pa.

[The editor herewith closes the discussion on eccentric riveted connections. The methods explained in the letters from our readers have illustrated the various ways of figuring such connections, but one drawback is found in all, that they are only applicable to symmetrical connections having the rivets placed in rows. This type of connection, undoubtedly, is most frequently met with in structural steel design. The method given in the Engineering Record of Nov. 7, 1914, page 518, however, is applicable to all kinds of eccentric connections, symmetrical as well as unsymmetrical.—EDITOR.]

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[*Contributions to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

Pile Pulling Methods Compared

A GALLOWS frame, with a derrick luffed to the heavy pulley tackle, is looked upon by many contractors as the best means of pulling piles under ordinary circumstances. Nevertheless, piles are sometimes pulled with a lever, and with a gin-pole. At first sight the lever method would appear the best, as with a moderate size lever and a 5-ton derrick, where there is a good "heel" close to the line of sheeting, a pull of 80 tons can be readily developed. To pull 80 tons with an ordinary hoist requires at least sixteen parts of line, and a heavy frame or gin-pole. As a matter of actual fact, a pull of 40 tons, possible with eight parts of line with a frame made of 12 x 12-in. timber, will draw out a sheet pile which cannot be budged with a lever of double the power. The reason is that the frame can be spotted to pull in direct line with the sheet pile, while the lever cannot. The blocking slips, or the lever in rising changes slightly in line of pull. Besides, it is difficult to adjust a hitch from the lever to the pile which will not throw undue strain on some one part, and breakdowns are constant. Then, too, the lever is more cumbersome to handle a gin-pole or gallows-frame.

A gallows frame is to be preferred to a gin-pole for this service. It is much stronger than a gin-pole, and is more easily set up, as it need be guyed normal to one plane only, while a gin-pole must be guyed in all directions. A short gallows frame was used for pulling steel sheeting on a St. Louis well foundation job which had braced sills under the posts, and required no guys. Where there is a place to set such a machine up it will pull piles faster than any other rig.

STEEL PILES PULLED WITH GALLOWS FRAME

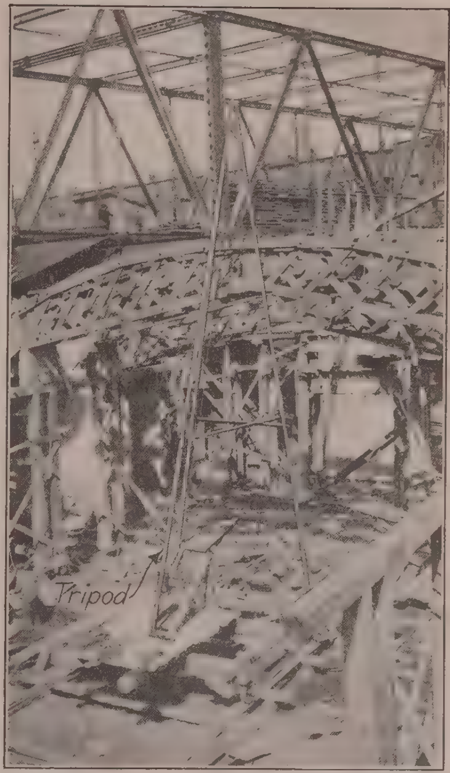
The riggers who advocate the gin-pole claim a longer pull without changing the hitch on the pile, as a gin-pole can be conveniently made taller than a frame. This is often a disadvantage, however, as when it comes time to drop the hitch, the hitch is inaccessible without considerable climbing, as it has been pulled up out of reach; and hitches will not always shake loose and slide down the pile as they should. As a matter of fact, the heavy pulling hitch need only be used for the first 10 ft., after which the derrick can pull the piles directly.

In reeving up the heavy falls for pulling long sheet piles, four to six sheave blocks should be used, depending on the power of the derrick. These blocks should always be rove from the center—that is, the lead line should enter the lower block on one of the center sheaves. If the blocks are rove in the ordinary way, the tilt of the blocks under strain, and consequent friction loss in the rope, takes all the strain out of the standing part and the parts next to it. This loads the blocks eccentrically, and will tear the lower blocks to pieces, if it is of ordinary construction, before three piles have been pulled.

Tripod of 3-Inch Pipe Sets Arch Centers in Close Quarters

A TRAVELING gin-pole consisting of a tripod of 3-in. steel pipe set on a four-wheel timber truck of 10-ft. gage was used to set arch centers in cramped quarters on a large section of the Fallsway viaduct in Baltimore. The truck was built like a turntable with an upper and lower frame 10 x 10 ft. in plan. Hoisting power was furnished by a hand crab. The three pipe legs rested on the outer timbers of the top frame and their footings, consisting in each case of two steel angle lugs between which the flattened end of the pipe leg was inserted and made fast by a horizontal pin. At the head of the tripod, each pipe-end was also flattened and a pin run through the three for the connection. Thus in erecting or dismantling, every joint was a hinge. Flat steel ties fastened to the legs about half way up by removable clamps were used to stiffen the structure. A single-line block and fall was used to handle the timber centering trusses. These trusses were 54 to 57 ft. span, and weighed about 2 tons each. The maximum lift was about 25 ft. Eighteen trusses were used to support the forms for each arch span.

In the portion of the viaduct which crosses the railroad yard, there was no opportunity to use a locomotive crane to move these centers from one span to the next. This traveler was designed to operate under these conditions as follows: A light track for the traveler was laid perpendicular to the roadway under the center of one span. The centers were then dropped from the preceding span, dragged forward within reach of the traveler, and set in place by it as it backed from one side of the viaduct to the other. The turntable feature of the traveler gave the necessary lateral movement for setting the trusses in correct position without the use of outhaul tackle. While this arch was being poured, a small crew dismantled the traveler and set it up again under the next arch. The rig was devised by Claiborne, Johnston & Company, of Baltimore, the contractors for the Fallsway viaduct.



LIGHT TRAVELER IN CLOSE QUARTERS

Pumping Through Well-Points Aids Excavation in Quicksand

By FRANK L. BARRETT

Ryan & Keon, Contractors, Boston, Mass.

NUMEROUS well-points connected to a 6-in. suction header and used in place of the ordinary means for unwatering the excavation for a bridge abutment greatly facilitated the handling of an 8-ft. seam of quicksand. A 22 x 40-ft. cofferdam in which the abutment was to be constructed was driven 4 ft. below the bottom of the quicksand. The foundation piles were next driven to grade with a follower and a water jet. The seam of quicksand, when unwatered, was so soft that men could not stand on it, and water boiled up dangerously along the sheeting.

A 6-in. pipe header was put around the cofferdam 19 ft. above sub-grade, and fitted with T-joints and valves from 3 to 5 ft. apart, to which 2-in. pipe drops were connected terminating in 60-mesh well-points 3 to 4 ft. long, driven 6 in. below sub-grade. Especial care had to be taken to make all pipe joints airtight. The header was connected to two 6-in. duplex pumps, one of which was held in reserve for use in case of breakdowns. All piping was boxed to facilitate the removal of the well-points. An outside-packed pump proved best for the service. A supply of extra valves, stems, etc., was kept on hand for use in case of emergency. Nine hours after the pump was started the pit was dry and men were excavating in it. After 12 hr. of excavation the pit was ready for concrete. The work described was in charge of the writer as superintendent.

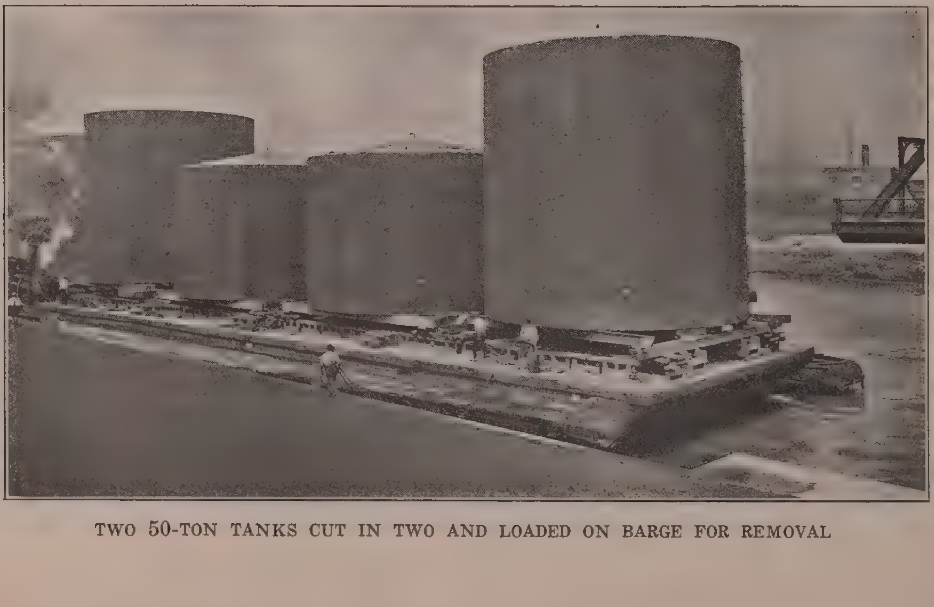
Cut Large Steel Tanks in Two for Removal on Barge

THE recent construction of the new Union Station at Chicago necessitated the removal to a new site several miles distant, of a large group of grain storage tanks which were transported and reestablished on their new foundations by the John Eichleay Jr. Company, of Pittsburgh. The 44 tanks were 40 ft. in diameter and as their height of 55 ft. was too great for transportation they were each cut in two on a horizontal plane a little above the center line and after moving the two pieces of each tank were riveted together as at first. The tanks were successively jacked up, needles and track timbers inserted under them, and they were rolled under a gantry frame from which tackles were suspended. The tackles were attached to the top of each tank and made fast to support it when necessary, and a horizontal course of rivets at the required elevation was cut out by men on temporary platforms bracketed to the exterior of the tanks.

The tops were lowered, carried 800 ft. and loaded on a large decked scow. When loaded with the tops and bottoms of two tanks, weighing altogether 100 tons, the scow was towed 6 mi. through the Chicago Drainage Canal, passing through 16 draw spans, and the tank sections were rolled on shore and over timber tracks, laid as required, for a distance of about 1500 ft., crossing the old Illinois and Michigan canal to the new site where a gantry lifted the upper sections to position on the lower sections. Then the whole tank was moved to its permanent position on new foundations and the two sections were riveted together by pneumatic hammers operated by men on the bracketed platforms.

Each tank was supported on four needle beams set on two track stringers 25 ft. apart, 100 10-ton screw jacks and 500 8-in. wooden rollers and 200,000 ft. b. m. of timber were used on the work which occupied an average gang of 15 men about 3 months. Where the tanks crossed the tracks of the Illinois Central Railroad it was necessary to build an incline 20 ft. high and 400 ft. long supported on timber cribs 4 ft. square and 4 ft. apart in the clear. Each line of cribs supported two 12 x 12-in. stringers 6 in. apart forming the lower roller track. The tanks were pulled up the incline by a six-part tackle operated by a hoisting engine anchored to a dead man.

The gantry used for lifting and handling the tanks was a double-bent gallows frame with transverse sills 24 ft. long giving it independent stability and serving for upper roller tracks. It had horizontal and vertical clearances of 44 ft. and 60 ft. respectively. The two bents were bolted together through 8-in. fillers and each was composed of two 12 x 16-in. vertical posts and two 12 x 16-in. caps 60 ft. long with the overhanging ends kneebraced and secured by adjustable wire ropes to the feet of the posts. Each cap was king-post trussed by a 12 x 12-in. strut and an adjustable wire cable.



TWO 50-TON TANKS CUT IN TWO AND LOADED ON BARGE FOR REMOVAL

Jack-Hammer Successfully Run with Steam on Sewer Trench Job

By CHARLES J. PHELPS
New York City

TWO jack-hammers operated with steam were used to cut a sewer trench in trap rock at New Britain, Conn., recently. The drills were fitted with wooden handles, and a short length of pipe, screwed into the outlet opening, conducted the exhaust steam away from the operator so that the drill runner found no discomfort in operating one of these machines with steam.

Steam was supplied from a small portable Ames boiler carrying about 80 lb. pressure. The coal consumption was less than ½ ton per week. Leading from the boiler was a 1-in, pipe line which ran along the ground beside the trench and was fitted with tees at convenient places for connections to the drills. The drills were fed through ¾-in. rubber steam hose. In the harder rock encountered a cross bit was employed, but for the softer rock a six-point bit was used. The rate of wages paid was $2.50 per 9-hr. day for the drill runners, and $2 a day for the laborers.

The speed of drilling varied greatly owing to varying hardness of the rock. Taking the average figure of 30 ft. of hole per day for each drill, the labor cost of drilling was 8 1/3 cents per foot of hole. Some drilling by hand had previously been done on this job, and by that method 15 ft. of hole per day was considered a good average for six men. With wages at $2 per day, the cost of labor for this hand drilling was 80 cents per foot of hole. The work was done by employees of the city of New Britain, under the supervision of John E. Moore, president of the New Britain Board of Public Works. The drills used were of Ingersoll-Rand pattern.

OPERATING A JACK-HAMMER WITH STEAM

[Editor's Note: The foregoing item is published because it shows an effective solution of a particular problem, and not because the use of steam in jack-hammers is to be advocated by reason of its cheapness where the conditions would otherwise call for the use of air. As only two operators were used on this work, they had an opportunity to become so familiar with the drills as to handle them with little danger of being burned. Also, as each driller was working by himself in a narrow cut below the surface, there was little danger of any one being scalded by the exhaust.]

Eleven-Foot Sewer Trench Excavated for 22 Cents a Foot

EXCAVATING ditches 2 ft. wide for sanitary sewers in Alton, Ill., was accomplished at the rate of 220 ft. per day and at an average cost of $30 per day. The Lillie Construction Company, using a small Austin gasoline ditching machine, excavated 19,800 ft. in 90 days, according to a paper presented by J. E. Schwaab, city engineer, at a recent meeting of the Illinois Society of Engineers and Surveyors. The maximum cut per day was 800 ft.

Average costs per foot were as follows: Operation of machine, 13.6 cents; incidentals, 1.4 cents; laying pipe, 4 cents; back-filling, 3 cents; total, 22 cents. The depth of trench averages 11 ft. while the maximum and minimum depths were 22 and 4 ft. respectively.

A Parson's steam machine with a backfiller was used to excavate 18,000 ft. in 90 days at a cost of $45 per day. The average depth was 11½ ft., the width 28 in. and the daily cut 200 ft.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Paris Solves Wartime Water Supply Problems

Burial of Dead on Watershed Forces Suspension of Dhuis Supply—Seine Water Filtered and Sterilized in Emergency

By F. M. WELDON
Paris, France

In the period which preceded its defeat on the Marne, the German army occupied the region lying between Chateau-Thierry and Montmirail, in which district are located the sources of the Dhuis stream. For its potable water supply Paris makes use of numerous small streams in the regions around the city, bringing each supply into town to common central points of distribution. The Dhuis is one of these streams, and at the time of the occupation of the Marne region the Germans made use of the water for the army supplies, and thus usurped the aqueduct of the Dhuis, cutting off this part of the city water supply. This action had no appreciable effect on the regular city water distribution of Paris, for this was only one of a number of similar sources of supply. Some damage was done to the aqueduct at this time. On the other hand, following the numerous combats which occurred in this region the bodies of men and horses were buried on the water shed. For all these reasons, the city water department considers that it will be impossible to put the Dhuis aqueduct in service at present, but its withdrawal from service is not felt to any great extent, for the city supply of potable water is well secured by the streams of the Vanne, Loing and Avre, as well as by filtered and sterilized water from the Seine, if need be. The Prefect of the Seine made a visit to the sources of the Dhuis in company with Dr. Thierry, chief of spring inspection. He prescribed all the necessary measures for avoiding the contamination of the underground water and for assuring the cleaning and sterilizing of the aqueduct.

Filter Seine Water

A recent incident allowed the Prefect of the Seine department to observe the great rapidity with which the Paris water department was able to take care of all difficulties such as the present war conditions might occasion. An ambulance camp had been installed in the region of the sources of the Avre, one of the streams used for Paris water, and on this account it was thought safer to cut off the Avre aqueduct from town. The deficiency in the city water supply was at once made up by an equal amount of filtered and sterilized water taken from the Seine, and the fact that the substitution could be made at short notice shows that there can never be any difficulty in connection with the water supply. However, it is intended to take the necessary measures to have the Avre aqueduct restored to its usual service before long. The Prefect of the Seine department and other officials made a visit to the filtering basins of Ivry and St. Maur for handling Seine water, and found that all was working in good order and that an abundance of such water could be turned at once into the city system should it be needed.

Ask for Two Millions for This Year's Work on Hetch Hetchy

Estimates for the work to be carried out during the coming construction season on the Hetch Hetchy water supply project were submitted to the Board of Supervisors of San Francisco on Feb. 17 by M. M. O'Shaughnessy, city engineer. The total estimated expenditure is $2,249,170. The largest item in this total is $1,475,000 for a railroad into the dam site; $40,000 is asked for clearing the floor of the Hetch Hetchy reservoir of trees and other kinds of debris, and $90,000 is needed for a diversion dam and tunnel.

There is included in this amount $500,000 for a municipal well system to be established near the Ocean Beach in San Francisco. This last item may not become necessary if the Spring Valley purchase is made by the city and immediate work started on the extension of that system's sources of supply.

Lower Court Declares Concrete-Arch Patent Valid

In accordance with a decision recently handed down by Judge Rose of the District Court of the United States for the District of Maryland, the use of steel reinforcement near the intrados and extrados of concrete arches is validly covered by patent 617,615 held by Edwin Thacher, of New York, and issued Jan. 10, 1899. The decree is granted on the first and third claims. The first claim reads: "The combination with abutments, and a concrete arch spanning the intervening space, of a series of metal bars, in pairs, one bar of each pair above the other, near the intrados and extrados of the arch, and extending well into the abutments, each bar of a pair being independent of the other, substantially as described." The third claim is similar to the first. The decision was made in the case of Thacher vs. Mayor and City Council of Baltimore. The infringing structure was the Fallsway Viaduct costing in the neighborhood of $2,000,000.

The city's defence was non-validity and non-infringement. It cited three respects in which its structure is unlike that covered by the patent: First, that upon its arches rest no spandrel filling; second, that the upper of each pair of its bars is not in precisely the same vertical plane as the lower, and, third, that its construction consists of a series of arches, one end of each of which in all cases, and both ends in most, are supported by piers rather than by abutments. These points of defense, however, were not held valid by Judge Rose.

Three Cities Combine in Sewage Treatment Scheme

At a meeting in Alhambra, Cal., Feb. 10, R. C. Orbison, city engineer of Pasadena, was elected chairman of the Tri-City Sewage Commission which is authorized to prepare plans and specifications for the treatment of the combined sewage of Pasadena, South Pasadena and Alhambra, and to select a site for a disposal plant, which will do away with the Pasadena City farm. The agreement, made last fall by the three cities, allows Pasadena 5 years in which to abandon the disposal farm at which the sewage is being treated at present. The commission as constituted at present consists of the chairman, City Engineer Hughes, of Alhambra, and City Engineer McMillan of South Pasadena. It is required to make its official report by July 14, 1915.

Engineers Place Three Different Valuations on Waterworks

Pursuant to the request of the Railroad Commission of California, the Peoples Water Company of Oakland filed copies of three valuations of its properties, prepared by as many different engineers, and rated on different bases. Cory & Cory evaluate them at $19,934,135, H. H. Shussler at $18,890,000 and Hazen & Whipple at $15,000,000.

Iowa Engineers Object to Technical Service Bureau

Claim that State College Extension Division Is Usurping Functions of Consulting Engineers in Municipal Matters

Serious objections were raised to the activities of the Iowa Technical Service Bureau by members of the State Engineering Society, which met Feb. 17, 18 and 19 in Iowa City. Claims that the bureau was usurping the consulting work of the engineer, the cream of his business, were freely made, as also were remarks to the effect that this arm of the State College's extension work was used to "drum up" business for the professors in the college. Although Dean Anson Marston explained that the aims of the bureau were to do research work and to educate small town officials up to the necessity and desirability of employing competent technical assistance, the engineers were not convinced that the move was not the forerunner of a State engineering bureau which would practically eliminate the municipal consulting engineer. These men were of the opinion that such a bureau, in co-operation with the League of Iowa Municipalities, might easily be extended to care for the engineering work of small towns just as the State Highway Department has taken over the engineering work on all but the largest bridges. The supporters of the bureau contended that it was making work for engineers and every reputable man had a fair field in which to work. The bureau has compiled a list of competent engineers to which it refers city officials if the latter request recommendations as to whom to employ.

"The whole 'list' was on hand," said one engineer in explaining how the system worked out. The city officials took bids from the consulting engineers; all engineers looked alike to them, and it was with difficulty that the more experienced men could persuade the officials to any other view.

The inspection bureaus see in the research division a material curtailment of their revenue. Dean Marston admitted that the limits to which the bureau's activities might be legitimately extended were hard to define and might give rise to delicate situations unless everybody concerned acted with absolute frankness. All correspondence and records were open to the public. An advisory board of twelve engineers has been appointed and he pleaded for a year's trial of the proposition.

Engineers desiring the passage of the engineers license law, soon to be presented for a public hearing, were importuned by Theo. S. De Lay, chairman of the legislative committee, to write immediately to their representatives. This bill was approved at the last meeting of the society.

Other legislation discussed related to a proposal to vest the State Board of Health with mandatory powers to compel the erection of sewage treatment works and garbage disposal plants, and to provide for the supervision and care of sanitary installations. By the provisions of the bill (Senate file 262) the board would proceed to make sanitary surveys throughout the State and would then determine what steps are necessary to purify or protect water supplies and proceed to order the work done.

Lafayette Higgins, engineer of the State Board of Health, followed the reading of the bill, which was not discussed or acted upon, with a paper on "The Degree of Purification Desirable and Practicable in Sewage Treatment Plants in Iowa." For carrying out the work of the board it is the intention to ask for $15,000 instead of the present appropriation of $5,000 per year.

Charles P. Chase, chairman of the committee to confer with the State Board of Health as to the form of plans and specifications to be submitted to the board, reported that the forms recently adopted in New Jersey were favored.

S. M. Woodward delivered an illustrated lecture on "The Dayton Flood Relief Project," in which he outlined the publicity campaign organized and the present status of the proposition.

In Dean Marston's report on the operation of sewage treatment plants, he emphasized the fact that few if any plants received adequate care. He advocated placing the attendant under bond to carry out instructions.

The officers elected for the ensuing year are: President, W. H. Kimball; vice-president, M. G. Hall; directors, J. W. Budd and S. M. Woodward. J. H. Dunlap, Iowa City, is secretary.

Minnesota Engineers to Aid Municipal League

Cities Requiring Technical Advice Will Be Referred to Competent Engineers—Invasion of Consulting Engineers' Field Discussed

Co-operation between the Minnesota Society of Engineers and Surveyors and the League of Municipalities of that State will be effected through a committee of the former society, which met Feb. 19 and 20, in St. Paul. The league has proposed to establish a bureau of engineering co-operation which will be largely educational and will be an added function of the Municipal Reference Bureau, a part of the extension service of the State University. With regard to the engineering bureau, its functions will begin when municipal officers write in for advice about public works. It will be pointed out that it is the poorest kind of economy to try to save an engineer's fee. The distinction will be emphasized between engineers who are engineers and those who are also contractors and agents for patented equipment. The bureau will aid in referring the officials to a reliable and competent engineer best suited to the particular job. The details have not been worked out, but the main idea is to emphasize the value of engineering on all municipal work. At the last meeting of the league one engineer was appointed to whom all such requests were to be referred. If he could not handle the work he was to designate someone to do so. Right here the Minnesota consulting engineers objected strenuously just as the Iowa engineers did as noted in the report of their meeting in another column of this journal.

No list is provided and only one man is designated. The Minnesota men forthwith proceeded to appoint a committee to confer with the league in working out the details of the bureau of engineering. The same general arguments of curtailment of the consultants' business as noted in the Iowa report were made at St. Paul.

A movement is on foot in Minnesota to repeal the law under which the State Highway Commission operates with the idea of reducing the central authority and putting it back into the hands of local boards. The society endorsed the present law.

The Governor is to be requested by the society to appoint two engineers on the State Board of Health. All members heretofore have been physicians. Other resolutions requested that the State Drainage Commission be put on the same basis as the State Highway Commission, and that the State appropriate funds to carry on hydraulic and geological investigations in conjunction with the Federal Government.

J. E. Carroll, superintendent of construction, St. Paul, presented a valuable paper on cost keeping and methods of laying 25 mi. of pavement last season. In general the 3½-in. wood block pavement cost $2.60 per square yard.

Experience with segmental vitrified sewer pipe from the contractor's standpoint was given by William Danforth.

C. E. Nagel spoke on a method of replacing an old wooden bridge floor with a concrete slab which is to rest on plank forms laid directly over existing steel floor beams. The State Highway Commission is developing the scheme for adoption this season.

A New Concrete Test

Prof. C. F. Shoop described experiments he had been making with concrete rings of 36-in. outside diameter and 28-in. internal diameter, with 8½-in. faces. These were tested in a Jones-Talbot rattler. The tests showed that crushed stone gave a better wearing surface than gravel, due to the superior bond, and that where the stones wore down at the same rate as the cement a better record was obtained. The tests are not conclusive enough, Professor Shoop stated, to arrive at standards or to warrant recommending them for standard testing purposes.

John Wilson described a unique booster pumping equipment to raise the sewage from Park Point, Duluth, and discharge it into the ship canal. The point is a narrow spit of sand occupied by summer resort cottages and although the sewers were all laid below lake level, extraordinarily small leakage was observed. Five automatically-controlled centrifugal pumps located in small manholes pass the sewage from one to the other and finally to the canal.

For next year the officers elected are: President, W. H. Hoyt; vice-president, F. W. Killip; secretary, G. H. Herrold, and treasurer, W. T. Rosenwald.

Heavy Seas Damage Jetty at Mouth of Columbia River

More than a mile of the south jetty at Astoria, Ore., at the mouth of the Columbia River, is reported to have been destroyed by the pounding of heavy seas. The jetty was completed only last spring, at a cost of $2,500,000. It is feared that years will be required to repair the damage.

Miniature Railway Feature of Wisconsin University Exhibit

A miniature railway electrically operated from a third rail will be a feature of the engineering part of the University of Wisconsin Exposition to be held March 19 and 20. The train will have automatic couplers and an electric headlight, and will operate an electric block signal system as it moves. Bridges, tunnels and other characteristic features of railway construction will be incorporated in the miniature line.

Correct grade-crossing practice and other railway safety devices will be illustrated as a part of the exposition. The engineering department will also exhibit a miniature construction camp. The exposition, which is held every four years, is for the purpose of acquainting prospective students and the State at large with the work being done.

Ohio Conservancy Act Again Reaches Supreme Court

As was expected, the opponents of the Ohio conservancy act have carried the case, arising out of the efforts to establish the Miami conservancy district, to the Supreme Court of Ohio. As before noted in this journal, this is the second time the flood conservancy case has been before the Supreme Court, the other time coming up on appeal. The Supreme Court decided that that method of procedure was not the proper one, and accordingly the case is now brought up on writ of error. The court indicated in the previous decision its belief in the constitutionality of the act, so that the advocates of the conservancy bill look forward with confidence to a favorable decision. The carrying of the case to the Supreme Court, however, prevents the original conservancy court proceeding with the hearings on the necessity for the organization of the district.

The bills now before the Ohio Legislature, which would emasculate the conservancy law, have not yet made any progress. Vigorous opposition to them has developed, and while the committee may report them favorably, it is believed that the Legislature will vote them down.

Liquid Chlorine Favored for Water Sterilization

American Waterworks Association Discusses Paper by F. F. Longley—Disagreement on Necessity for Standard Specifications for Meters

"Liquid chlorine will soon replace hypochlorite of lime as a sterilizing agent for water supplies." This was the prediction made by Dr. Hale of the New York water department in discussing Francis F. Longley's paper on "Present Practice with Hypochlorite and Chlorine," presented Feb. 24 at the meeting of the New York section of the American Waterworks Association. The apparent unanimity in this belief, supported by Francis D. West, of Philadelphia, contrasted strongly with the marked difference of opinion as to the advisability of adopting some form of standard specification for water meters. Allan W. Cuddeback suggested certain general lines upon which the work of standardization might proceed, but John C. Kelley of the National Meter Company opposed the plan on the ground that any radical changes in the present types of meter would be a hardship to the manufacturers who were, at present, confronted with the problem of purchasing material for meters at higher prices than heretofore and selling their product at a smaller profit. But if it was felt that meter standards were necessary, Mr. Kelley said, the meter men could be depended upon to co-operate with the association.

Mr. Longley's paper on current practice in water sterilization was based upon 110 replies received from 240 inquiries sent to heads of water departments. It was replete with valuable statistics on the extent to which sterilization has been used since 1908, costs of installation, costs of operation—which averaged about 25 cents per million gallons—materials employed for tanks and piping, and results in lowering the typhoid death rates.

In discussing the paper Dr. Hale said that liquid chlorine had proved to be twice as active a sterilizing agent as hypochlorite. Francis D. West, of Philadelphia, presented figures showing that since the use of liquid chlorine had begun in that city the cost of water sterilization had been reduced from 30 to 40 per cent. The 1914 figures for the Torresdale plant were 7.4 cents per million gallons.

On the question of a standard specification for water meters Mr. Cuddeback suggested the following: A uniform mixture of metal; standard over all sizes; limits for accuracy, sensitiveness, and revolutions per volume of water. Mr. Kelley, speaking for the manufacturers, contended that a standard mixture of metal was not desirable, but Allen Hazen disagreed with him on this point. Mr. Reimer, of East Orange, was a strong advocate of standardization for meters.

The program concluded with a paper on determining the size of taps and meters by Jacob Klein, of the New York Water Department.

Oklahoma to Have Highway Department

A bill abolishing the office of State highway commissioner and creating a highway department with authority to appoint a State highway engineer was passed by the House of Representatives of the State of Oklahoma, Feb. 18.

Exhibits at the Panama-Pacific International Exposition

Land, water and air transportation are all featured in the transportation exhibit at the Panama-Pacific Exposition. The display of locomotives includes the heaviest Pacific, Mikado and Mallet types, the logging engine for the sharpest of curves, and electric locomotives of various sorts, for both passenger and freight service. The latest types of equipment in super-heaters, special designs of trailing trucks, power reversing mechanism, mechanical stokers and valve gears are there. Freight, passenger and mail cars of the latest designs are to be seen, together with track appliances, signals, safety devices and many other appurtenances of the modern railroad. For purposes of comparison there is shown an old-fashioned stage coach—one that has seen actual service.

In the marine division there are numerous large sized models of trans-oceanic steamships, and also full sized sections of interesting parts of the modern ship. Pleasure craft of all sorts are also exhibited.

A model of the Langley aeroplane, the forerunner of the heavier-than-air machine, is on display, as are the latest types of monoplanes, biplanes, triplanes and hydroplanes. The automobile also is seen in all of its forms, from the pleasure car to the utilitarian motor truck. The automobile section includes exhibits of the methods of producing gasoline and other essentials of automobile operation.

Pennsylvania Railroad's Exhibit

Mention was made in these columns last week of the large relief map and other features of the Pennsylvania Railroad's exhibit. In addition the company has just issued a booklet, for distribution at the exposition, describing the company's exhibits, showing photographic views of the relief map and the various models on display, and setting forth statistical information as to the Pennsylvania system.

Pelton Water Wheel Exhibit

The feature of the exhibit of the Pelton Water Wheel Company is a 20,000 hp., single discharge runner, Pelton-Francis turbine, designed and built for direct connection to a 15,000-kva. alternating current generator. This unit is designed to operate at 360 r.p.m. under an effective head of 500 ft. The turbine will be set up complete, except that the runner will be left out. The runner will be mounted on a special stand so that its design and its many special features can be displayed. The governor of the unit is of the direct motion type, being built integral with the turbine. It exerts a cross-head pull of 40,000-ft. lb. Some idea of the duty which this governor performs can be obtained when it is taken into consideration that the total output of 20,000 hp. is controlled by a peripheral movement of the guide vane operating ring somewhat less than 4 in.

There will also be on exhibition a deflecting needle nozzle and the tangential wheel which it drives, both of which have been designed for the development of 10,000 hp. under an effective head of 1350 ft. This Pelton-Francis turbine and the deflecting needle nozzle and tangential wheel are placed on exhibition through the courtesy of the Pacific Gas & Electric Company, for whom these have been built on contract.

Among the other interesting features of the exhibit will be a number of smaller types of Pelton wheels, including the well known Pelton-Doble laboratory motor, an exact duplicate of the laboratory installations that have been made in many of the prominent technical schools of the world.

Bureau of Standards

Divided into three distinct sections, the exhibit of the Bureau of Standards at the Panama Pacific International Exposition will comprise, first, standards and methods of measurement, electricity, magnetism, heat, thermometry, optics, and chemistry; second, a model weights and measures outfit, together with the methods and devices whereby the purchasing public may protect itself against fraud; third, structural and engineering materials, including specifications, use and actual tests.

Coast and Geodetic Survey

An automatic tide gage, electrically connected to show the stage of the tide in San Francisco Bay, and serving to illustrate one of the means by which the Survey furnishes local tidal data to maritime associations, will be one of the principal features of the exhibit of the Coast and Geodetic Survey at the Panama Pacific International Exposition. Included in the exhibit will be a small tide-predicting machine, tide rolls, various instruments used by the Survey in its field work, mounted as in field use, views of surveying operations and chart construction, and finished charts. There will also be on hand for free distribution a publication entitled "The Work of the Coast and Geodetic Survey," and a map of San Francisco and Bay with a sketch of the Exposition grounds.

To Prevent Recurrence of Storm Damage in Southern California

In the wake of the recent storm that caused serious damage at the beach resorts of southern California, as reported in the Engineering Record of Feb. 6, there is much activity and interest in plans for protecting the beaches from further damage, as well as for restoring the sand at those points where it has been carried away by the waves. A contract has already been awarded for rebuilding the Venice pier, and the cities of Venice and Longbeach are considering immediate steps toward whatever type of construction is finally decided upon as best suited to protect the beaches and adjacent property.

At a well attended mass meeting in Venice Feb. 6 it was decided to authorize the city trustees to appoint a committee of ten to report on the best way to reclaim and retain the south beach. It was agreed that this object could probably be attained without the construction of either a breakwater or a bulkhead, and that Congress should be approached in regard to making an appropriation toward the cost of this work. From reports made at this mass meeting it was shown that the business district in Venice would have been inundated during the storm if it had not been for the breakwater and pier that now exist on the ocean front. The contract for rebuilding the portion of the Windward Avenue pier of the Abbott Kinney Company which was destroyed during the storm was closed on Feb. 4. The work will cost about $25,000.

At Longbeach a number of schemes for beach protection have been proposed, among which are the construction of a 4-mi. seawall from Devil's Gate to the harbor entrance, to cost about $750,000, and the placing of timber groins at frequent intervals along the entire length of the beach and extending about 150 ft. out into the water. The most comprehensive plan is proposed by W. D. McKinney for use on all the beaches. He suggests a system of sheet piling driven so as to form a series of pockets 4 ft. high above low tide and with centers staggered so that each row paralleling the surf line is braced at its center by the row at right angles behind it. These pockets, he asserts, could be effectively built of 2 x 10 and 2 x 12-in. planks 8 ft. long, and would constitute permanent retainers of the sand on the usual beach slope at the same time that they served as a barrier in time of storm.

Chicago Plans Record Road Year

If the plans of the Chicago Board of Local Improvements are carried out 175 mi. of streets will be resurfaced and improved in 1915. This will break all road construction records for Chicago.

Huge Pumps Begin Reclamation of Louisiana Marsh Lands

Five pumps, discharging 1,000,000 gal. of marsh water per minute, were put in operation by President Wilson on Feb. 13, thus starting the draining of 40,000 acres in the Jefferson-Plaquemine district in Louisiana. The pumps were started by an electric circuit closed at Washington, D. C. The district, sponsored by the State of Louisiana, is part of an extensive scheme of systematic reclamation of alluvial lands, which will eventually bring into use 10,000,000 acres of land now idle and awaiting development.

Concrete Pipe Men Gather for Convention in Chicago

The American Concrete Pipe Association held its annual meeting in Chicago Feb. 15 and 16. Among the papers presented were "Concrete Sewer Pipe," by Lewis R. Ferguson, assistant secretary of the Association of American Portland Cement Manufacturers, and "Use of Bulk Cement in Concrete Products Plants," by P. W. King.

M. I. T. Sends Education Emissaries to South America

The Massachusetts Institute of Technology is represented on a 12,000-mi. commercial cruise which will circumnavigate South America by two alumni, Paul G. L. Hilken and Roger W. Babson, who will spread information about American methods of technical education. The chief feature of this campaign is a small pamphlet in Spanish containing a brief statement of what the Massachusetts Institute has to offer new students, and information as to how to get further particulars. This pamphlet was written by Rafaele Alfaro, a Spanish-American engineering student who is president of the Tech Cosmopolitan Club. Meetings have been arranged for the Technology alumni in South America, of whom there are a considerable number, to take place at various points on the route of this commercial tour, and good results are expected in acquainting our South American neighbors with our educational methods and ideals.

Colonel Goethals Tells Story of Canal Building

Scribner's Magazine for March contains the first installment of Colonel Goethals' own story of the building of the Panama Canal. It takes up the selection of the Army-Navy commission with Colonel Goethals at its head and his reasons for advocating the construction of the canal by force account rather than by contract. The discussion on the latter subject occupies over half of the fourteen-page article.

The following sentences from the article are of special interest: "Considering the work as a whole, were it to be done over again in the light of experience gained by its construction, I would advocate employing again the method [force account] that has been followed. . . . The work has been completed within the time limit fixed by the International Board of Consulting Engineers in 1906, notwithstanding the increased dimensions of the locks and the unexpected difficulties which developed in excavating the channel through Culebra Cut. Also, leaving out of consideration the accessories undertaken in 1912, and not originally contemplated, it has been built within the estimated cost. . . . I am free to say that were I to do it over again I could build it more cheaply, and such a result could have been secured had I received the loyal support and co-operation of all my associates."

The second article of the series, on "Labor Problems Connected With the Work," will appear in the April number of Scribner's.

News of Engineering Societies

The Engineers' Society of Western Pennsylvania will hold a meeting March 2, at which it will hear a paper on "Protection of Metal Structures," by Frederic H. Fay, consulting engineer, of Boston.

The Associated Engineering Societies of St. Louis held a joint meeting Feb. 17, which was addressed by T. H. Rogers on the work of the efficiency board of the city of St. Louis, of which Mr. Rogers is chairman.

The Cornell Society of Civil Engineers on Feb. 18 entertained the Harvard Engineering Society at a smoker in New York City. Professor Jeremiah W. Jenks spoke on the subject of the relation between capital and labor.

The Institution of Civil Engineers of Great Britain, at the ordinary meeting, Feb. 9, admitted the following American engineers as members: Wm. A. Cattell, San Francisco; George W. Fuller, New York, and William C. Cushing, Pittsburgh.

The Engineers' Club of Trenton, N. J., has invited Mayor Donelly to advise in detail the manner and way in which he thinks the Engineers' Club may be of service to the city relative to the proposed investigation of Trenton water power.

The Harvard Engineering Society of New York will hold a meeting at the Harvard Club, March 3. Miller Reese Hutchison, chief engineer of the Edison laboratory, and personal representative of Thomas A. Edison, will lecture on "Edison and Some of His Inventions." The members of the new Yale Engineering Association will be the guests of the Harvard society at this meeting.

The Lake Michigan Water Commission will hold a meeting in Milwaukee, March 19. The topics for discussion will be the progress of the various States and cities since the publication of the last report in 1911. T. Chalkley Hatton will talk on the subject, "Preventing the Pollution of the Lake at Milwaukee." Other papers will be presented by H. E. Barnard, Indiana State Board of Health; E. D. Rich, Michigan State Board of Health, and Dr. Edward Bartow, Illinois State Water Survey.

The Boston Society of Civil Engineers will hold its annual meeting on March 17 at the Boston City Club. The business meeting will begin at noon and the annual dinner will be served at 2 p. m. in the banquet hall of the club. In the evening a smoker will be held. The sanitary section of the society will hold its annual meeting at the Boston City Club, March 3, at 6 p. m. The speaker of the evening will be David A. Hartwell, chief engineer of the sewage disposal commission of Fitchburg, Mass.

The Engineering Society of Wisconsin held its seventh annual meeting at Madison, Feb. 22 and 23. The following are some of the papers which were presented: "Modern Sewage Disposal Processes," by T. Chalkley Hatton, chief engineer, Milwaukee Sewerage Commission; "Drainage Problems in Wisconsin," by Prof. E. R. Jones; "Needed Highway Legislation in Wisconsin," A. R. Hirst, state highway engineer; "Some Causes of Bad Pavements in America and Their Remedy," by Prof. L. S. Smith, and "Construction of Milwaukee's New Waterworks Intake," by George I. Staal, city engineer. Prof. D. W. Mead presented an illustrated paper on engineering in China.

The Engineers' Club of Philadelphia is considering a plan whereby the other engineering societies of the city will become affiliated members of the Engineers' Club and enjoy the privileges of its headquarters for their meetings, upon the payment of a nominal price by each of the members of the affiliated societies. These societies will also be represented on the board of directors of the Engineers' Club. It is believed that this arrangement will be consummated some time in the spring. At the organization meeting of the board of governors on the evening of Feb. 16 the following Public Relations Committee was appointed: S. M. Swabb, Coleman Sellers, Jr., W. Purves Taylor, John C. Trautwine, Jr., Carl Hering, H. H. Quimby, Edgar Marburg, John Birkinbine, Walton C. Clark, S. M. Vauclain and William Easby.

Personal Notes

J. B. Wickware, civil engineer and surveyor, has been appointed superintendent of public works for Rutherford, N. J.

R. O. Wynne-Roberts will terminate his engagement as consulting engineer for the Regina (Sask.) City Council, May 31.

Dwight La Du has been named deputy engineer in charge of barge canal terminals by State Engineer Williams of New York.

William L. Saunders, president of the Ingersoll-Rand Company, was elected president of the American Institute of Mining Engineers at the meeting in New York, Feb. 16.

C. O. Vandevanter, assistant engineer in charge of maintenance of streets in the city engineer's department of Baltimore, has tendered his resignation to take effect March 1.

Sidney Diamant, consulting engineer, of New York City, has been retained as consulting structural engineer for the Lambs' new club-house to be erected at 132-134 West 44th Street.

Thomas R. Tetley, Jr., formerly engineer in charge of State Barge Canal construction at Waterloo, N. Y., has been appointed designing engineer for the Lake Erie and Ohio River Canal Board, Pittsburgh, Pa.

Charles W. Hotchkiss, who for many years has been engaged in engineering work, has been elected chairman of the board and of the executive committee of the Virginia Railway Company, with headquarters at New York.

H. S. Morse has been elected director of the Cincinnati Bureau of Municipal Research. In accepting this new office Mr. Morse retains his connection as engineer with the Ohio Institute for Public Efficiency, Columbus, Ohio.

Edward P. Burch, who was one time electrical engineer and later consulting engineer for the Twin City Rapid Transit Company of Minneapolis and St. Paul, has opened an office in Detroit, Mich., with Lester M. Sears as associate.

Raymond Du Puy, formerly vice-president and general manager of the Virginian Railway Company, has been elected president with headquarters at Norfolk, Va. Mr. Du Puy served as chief engineer of the Tioga Railroad Company, from 1881 to 1885.

Walter G. Kilpatrick, recently city engineer of Birmingham, Ala., and special engineer in the executive department of the Alabama Power Company, has opened an office in Birmingham to resume his practice as consulting engineer, specializing in hydraulic and municipal work.

William S. Wolfinger was appointed highway engineer by the Cheltenham (Pa.) board of township commissioners. Mr. Wolfinger has been connected with the Pennsylvania State Highway Commission as superintendent of roads. He succeeds William McIntyre, resigned.

C. H. Barron has opened offices in Lewiston, Maine. For the past five years Mr. Barron has been chief engineer of the Portland-Lewiston Interurban Railroad. Previous to that he was connected with the Lewiston, Augusta and Waterville Railroad, during the preliminary surveys and construction.

Capt. Alvin B. Barber, Corps of Engineers, U. S. A., has been detailed as a member of the board of officers of the Corps of Engineers, considering matters relating to the organization, equipment and instruction of that branch of the military service. He succeeds Capt. Robert R. Ralston in this position.

Dr. Herman Schneider, dean of the school of engineering of the University of Cincinnati, has been retained by the New York City Board of Education at a salary of $10,000 a year to spend one week of each month in this city, demonstrating the possibilities of introducing the co-operative system of industrial education.

E. H. Baldwin, who has been engineer in charge of construction of the Elephant Butte dam on the Rio Grande River, will succeed F. W. Hanna as supervising engineer of the southern division of the U. S. Reclamation Service. Mr. Hanna, according to press reports, will be the Reclamation Service member of the Salt River project cost review board.

Robert M. Feustel, chief engineer of the State public utilities commission of Illinois has tendered his resignation from that office, to take effect March 1. Mr. Feustel, who is a member of the firm of Sloan, Huddle, Feustel & Freeman, and was formerly assistant chief engineer of the railroad commission of Wisconsin, resigns for the purpose of resuming his consulting practice.

R. M. Hosea has resigned as chief engineer of the Colorado Fuel & Iron Company, the Colorado & Wyoming Refining Company and the Crystal River Railroad. He will be retained as consulting engineer with these companies and in addition will open a consulting engineer's office in Pueblo, Col., specializing in coal mine engineering operation, water supply and irrigation construction, engineering reports and examinations, wood-stave pipe and concrete structures and administration of water-supply systems. Mr. Hosea designed, constructed and for the past seven years operated, the $1,000,000 water-supply system for the steel plant of the Colorado Fuel & Iron Company at Pueblo, Col.

Obituary Notes

Fred Sauerbrey, formerly chief engineer of the Newport (N. Y.) waterworks, died Feb. 15.

Philip H. Porthesius, former assistant chief examiner of the State Civil Service Commission of New York, died Feb. 16. Previous to his appointment as chief examiner Mr. Porthesius had practiced as an engineer.

Sir Charles A. Hartley, the hydraulic engineer, died in London, Feb. 22. In this country he was one of the committee appointed by Congress to report on the improvement of the Mississippi River in 1875. He was also a member of the congress that sat at Paris to decide upon the best route for a ship canal across the Isthmus of Panama.

Civil Service Examinations

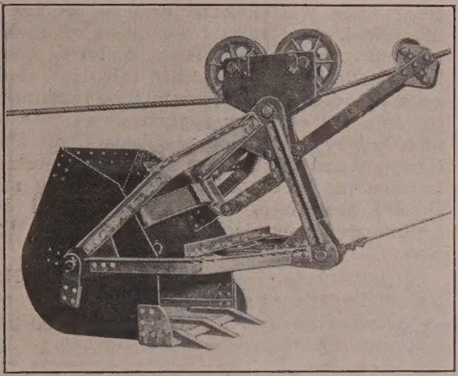
Chicago.—The Civil Service Commission will hold an examination for the position of bridge designing draftsman, salary $1500-$1740, March 12.

Examinations Previously Announced

Date		See Eng. Record
March 2	—Designing engineer, United States	Feb. 6
March 10	—Aid, Coast and Geodetic Survey; computer, Coast and Geodetic Survey; copyist topographic draftsman, departmental service; junior engineer draftsman; topographic draftsman; surveyor, Philippine service; superintendent of construction, supervising architect's office; United States	Feb. 6
April 14	—Civil engineer and draftsman; copyist draftsman, Navy Department; mechanical draftsman, Panama Canal Service; ship draftsman, Navy Department; topographic draftsman, Panama Canal Service; engineer, Indian Service; United States	Feb. 6

Reversible Drag-Line Bucket for Double Wear

A small capacity 1-yd. drag-line excavator whose structural steel frame is designed to throw the trolley weight ahead of the bucket, putting the maximum weight on the digging edge, was exhibited for the first time at the recent Chicago Cement Show. The frame is triangular-shaped and provides for straight draft on the bucket while elevating the trolley sufficiently to keep the track line clear of it. The dumping trolley can be reversed, which allows the bucket to be dumped at the foot of the incline as well as the top. When digging in sticky material by operating the latch the bucket can be turned over, insuring complete discharge. The bucket is symmetrical in form and hence reversible in its carrying frame. Thus after the first digging edge and side are well worn, the digging lip can be transferred to the other edge and the bucket turned in the frame to give another full period of usefulness. The buckets, which are also made in still smaller sizes, are manufactured by the Raymond W. Dull Company, Chicago.



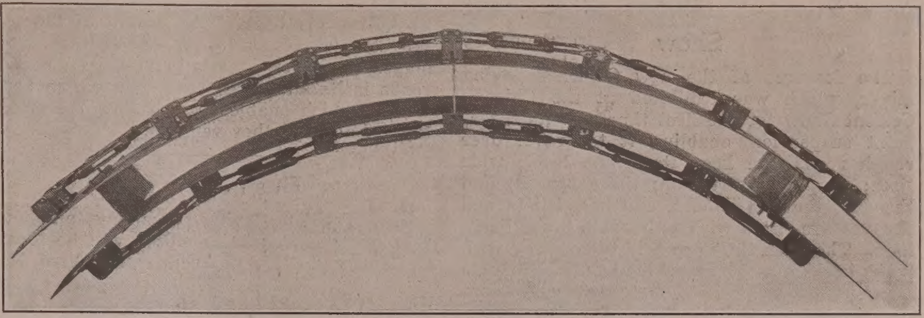
THE DIGGING LIP OF THIS DRAG LINE BUCKET MAY BE TRANSFERRED TO GIVE LONGER SERVICE

Revolving Steam Shovel Cuts to Accurate Grade

Extra reach, both in width and height, and rapid operation made possible by simple control are features which will recommend the Erie steam shovel. Automatic control of the crowding engines sets the dipper handle at each operation and holds it to grade in digging, producing the level cut shown in the accompanying illustration without extra attention on the part of the operator. Although the crowding motion is of the direct-acting shipper-shaft type, the advantage of other crowding motions adapted to shallow cut work have been incorporated in the design, and it is claimed that cuts as shallow as 1 ft. can be excavated at the rate of 30 yd. per hour. The extra reach enables a 35-ft. floor to be dug from one position by the ¾-yd. shovel. Three levers and one foot-brake entirely control the shovel in digging, one lever operating both the throttle and clutch of the main hoist. By thus simplifying the control, a shovel runner of only average ability is enabled to put out a high yardage. It is said that from one to six loads per minute can be handled by such a man with this machine. The shovel is self-propelling, and has a power steering-device. It is claimed that the shovel will climb a 20 per cent grade on its own power. Wagons do not have to be accurately spotted for this shovel, and can be loaded 23 ft. from the center of the shovel, or on a bank 8 ft. above the pit floor. This is the first steam shovel put out by its makers, the Ball Engine Company, of Erie, Pa., and long working tests of the machine were made before offering it for sale. These tests seem to indicate that the accuracy with which the automatic crowding device enables the shovel to dig to grade will cut the pit crew employed with it on road grading to one man.

REVOLVING STEAM SHOVEL WITH EXTRA REACH IN WIDTH AND HEIGHT

Adjustable Steel Curb Form Exhibited at Cement Show



STEEL CURB FORM WHICH MAY BE ADJUSTED TO ANY RADIUS OF CURVE

An adjustable steel circle form for plain curb, curb and gutter and road work, was exhibited for the first time at the recent Chicago Cement Show. The form is made of spring steel curved by a system of turn-buckles and can be adjusted to any radius or a reverse curve. It is claimed that the form is as cheap as the wooden ones and can be laid at 2.4 cents per linear foot cheaper. It enables the contractor to finish corner curbs with the rest of the straight form work. The form is manufactured by the D. D. Baker Company, Detroit.

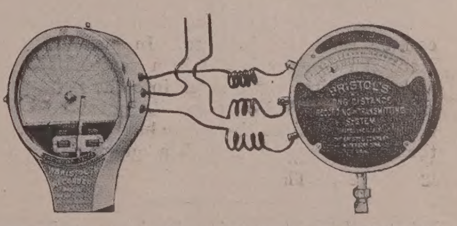
Wrecking Crane Driven by Either Steam or Electricity

A 120-ton wrecking crane which can operate with either steam or electricity was recently bought by the Michigan Central Railroad for use in and near the Detroit River tunnel. This crane, which was made by the Industrial Works, Bay City, Mich., is like a standard wrecking crane, except that it has a complete set of electric and steam engines for performing each operation. When working within 500 ft. of the electrified zone current can be supplied to the crane through an insulated cable, which is wound on a special motor reel. This reel winds up or pays out this cable automatically as the crane moves. For service beyond the reach of the cable the crane may be connected through flexible piping to any convenient steam supply, such as a locomotive. The crane can propel itself with either steam or electricity at 4 mi. per hour. Its electrical equipment is designed to operate on fluctuations of line voltage ranging from 300 to 700 volts.

Electric Device Records Pressures and Temperatures at Distances

A long-distance electric transmitting and recording system for pressures and temperatures, believed to meet commercial requirements in a practical way, has recently been placed on the market by the Bristol Company, of Waterbury, Conn. The device is deemed of importance to all power plants, waterworks, etc., requiring for efficient operation records of pressure or temperature from distant points. Frequent visits to these points require a great deal of time. By using the device the engineer or manager of the plant can tell, from records at his desk, whether a certain tank is overflowing or whether water is going over the dam.

The device consists of a standard Bristol pressure-gage movement to which is attached an electrical transmitter operating on the induction balance principle. As the pressure-gage movement is affected by change in pressure it causes a change in position of the electrical transmitter, so that the corresponding changes in pressure are accurately transmitted to a receiving instrument located at any desired point, regardless of the distance from the source of pressure. Alternating current is, of course, necessary for the operation of this device, and three small wires of No. 18 size or slightly larger connect the transmitter with the recorder. In fact, a distance as great as 30 mi. between these two pieces of apparatus could be negotiated by using No. 14 wire.

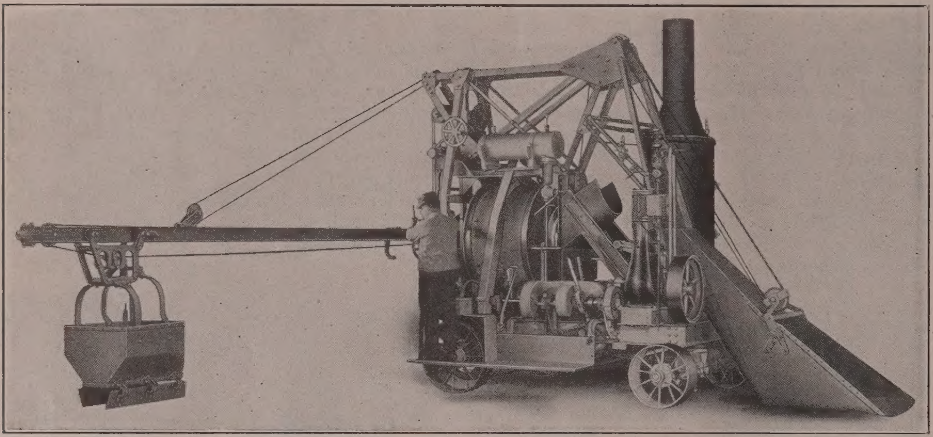


RECORDERS OF LONG-DISTANCE TRANSMITTING SYSTEM

No electrical contacts are made or broken in connection with this instrument, as the movement consists simply of two small coils which are moved back and forth over iron cores changing the magnetic field for the corresponding changes in pressure. This is considered an important feature, as sliding contacts, or contacts which have to be made and broken at certain intervals, are absolutely avoided. It is this feature which makes it possible for the instrument to operate for long continued periods with practically no attention. The electrical transmitter is mounted in a small moisture-proof case which protects it from all moisture and dirt.

New Paver Exhibited at Cement Show

The features of the new Oshkosh paving mixer, which was exhibited at the Chicago Cement Show for the first time, are its three-point suspension, enabling it to travel over rough roads and keep its frame level; wide tires; simple construction; three speeds; and the fact that all rollers, clutches, hoists and sheaves are fitted with removable brass bushings. The wide tires are said to do away with plank breaking. The machine has two forward speeds and one reverse, the slow speed being used on planks and the faster one for moving from job to job. The machine, which can be obtained with boom and bucket or telescopic distributing chute, is made in 14 and 22-cu. ft. sizes.



NEW TYPE OF MIXER WITH THREE-POINT SUSPENSION FOR PAVING WORK

Bag Splitter Measures Cement in Less than Bag Batches

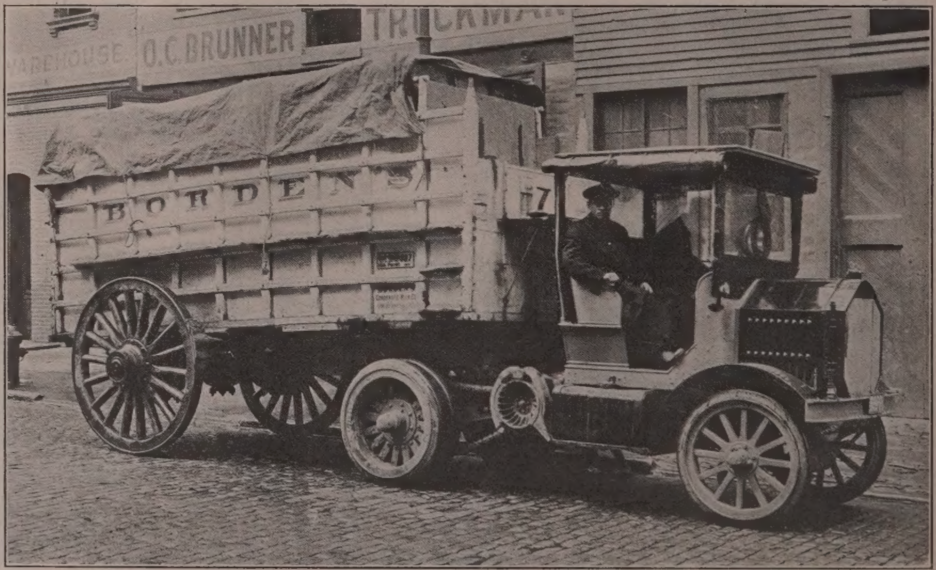
A device for measuring one-half a sack of cement, perfected by W. J. Cullen (30 Church Street), New York representative of the T. L. Smith Company, Milwaukee, was exhibited by that company for the first time at the recent Chicago Cement Show. The Cullen bag splitter, as it is called, consists of a galvanized iron pail 12 in. in diameter and 18 in. high with a circular damper in about the center of the pail.

By means of the bucket handle the damper can be raised or lowered. In measuring cement the damper is put in a vertical position and the entire bag dumped into the pail. Then the handle is raised from its normal to carrying position and the upper half dumped, then the handle turned through a quarter turn and the rest dumped.

Motor Tractor with Drive on Front Axle of Trailer

A motor tractor which carries a 10-ton load supported on an independent set of springs several times as stiff as those used to support the power plant and driver's seat has just been perfected by the Knox Motors Company of Springfield, Mass. The front part of this tractor is literally pushed along by two strut rods from the front axle of the trailer, and it is free of move vertically on its own springs independent of the load. A feature of the transmission is a differential lock which is said to be an improvement over those now in use.

The tractor is provided with both a foot and a hydraulic brake, the former operating on the jack-shaft, and the latter operating internally on the rear axle. Either brake can be locked to hold the tractor when standing on a grade. The feature of having the drive under the front end of the load enables the tractor to develop maximum power in pulling over obstructions. The engine is designed to develop maximum power at 1000 r.p.m., which, with gears in high speed, propels the truck at 9.4 mi. per hour. The weight of the tractor complete is 8500 lb. A feature which makes the truck especially useful on country roads is its standard tread, unusual in heavy trucks, which enables it to follow the smooth track made by other vehicles.



TEN-TON MOTOR TRACTOR WITH DRIVE ON FRONT AXLE OF TRAILER

Business Notes

The Topeka Paving Company announces that after March 1 its offices will be located at Canal and Stillwell Avenues, Brooklyn, N. Y.

The Troy Wagon Works Company has selected J. L. Keis as its Philadelphia representative. Mr. Keis's offices are located in the Abbot Building, corner of Broad and Race Streets.

The Kerr Turbine Company, of Wellsville, N. Y., announces the appointment of J. S. Huey, 418 Hibernia Bank Building, New Orleans, as its district sales agent for the states of Louisiana and Southern Mississippi.

H. C. Morrison, formerly sales manager of the McCormick Waterproofing Company, is now western representative and waterproofing expert for the Sandusky Portland Cement Company, with offices at 710 Railway Exchange Building, St. Louis, Mo.

The Walter A. Zelnicker Supply Company, of St. Louis, has brought out a sand-dryer which it is claimed will dry from 3 to 10 tons of sand per day. These dryers are made in three sizes, holding at one time from 7 to 18 cu. ft. each. The heating apparatus is a dome-shaped stove, around which is a fine cast grating. The whole is surrounded by a sheet-iron skirt. The wet sand is shoveled in on top, runs between the stove and the grating as it dries, and falls to the ground through a perforated screen at the bottom.

The Lakewood Engineering Company will open an office in Baltimore, March 1, to care for the territory consisting of the states of Maryland, Delaware and Virginia, the District of Columbia, eastern Pennsylvania and southern New Jersey. This office will be in charge of Lloyd Brown, who for the past few years has been in charge of the company's car department in New York. This company has been represented in Baltimore by the Eastern Railway Supply Company as agents.

Trade Publications

The following companies have recently issued trade publications:

Chain Belt Company, Milwaukee, Wis. General catalog, No. 56, bound, 6 x 9 in., 300 pages, illustrated. A complete treatment of elevating and conveying machinery, featuring Griplock (malleable) and Chabelco (all-steel) chain belts, sprocket wheels, transmission machinery, elevator and conveyor appurtenances. As an introductory a few facts about the Chain Belt Company and illustrations picturing important installations of elevating and conveying machinery are given. Tables and general descriptions follow each classification in the book.

National Tube Company, Pittsburgh. "National" Bulletin 11-C, second edition enlarged, 48 pages, illustrated, 8½ x 11 in., entitled "History, Characteristics and Advantages of National Pipe." The bulletin presents the story of the National Pipe Company, with facts regarding the progress of pipe development during the past century. It also treats of the processes of manufacture, of pipe threading, spellerizing, physical properties and resistance to corrosion of National pipe. Considerable attention is given to the latter subject, abstracts of papers quoted as authorities being printed together with tables of tests.

Cheesman and Elliot, National Paint Works, 100 William Street, New York City. Booklet, 6 x 9 in., 52 pages, illustrated, ninth edition of the "Review of Technical Paints," edited by Frank P. Cheesman. The object of this publication is to give authentic paint information. Brief specifications for paint for technical use form an introduction to the book. Following is a treatise on technical paint, giving information obtained from research and experience. The causes of paint decay, pigments and vehicles and coatings for reinforced concrete and cement, for steel bridges and for certain other specialized engineering uses are discussed. The last 15 pages treat in detail of the paints made by Cheesman & Elliott and of their special uses.